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Description

~~Electronic~~ Part Inspection Apparatus

Technical Field

The present invention relates to an electronic part inspection apparatus which gives various inspections to package parts such as a package IC, or electronic part such as a bare chip which is diced from a wafer.

Background Art

In the manufacturing process for electronic part such as a semiconductor device, various inspections need to be given to electronic part such as an IC which are finally manufactured. For example, there is known a device inspecting apparatus (i.e., an electronic part inspection apparatus), as disclosed in Japanese Patent Laid-Open No. 10-148507 (as a prior art).

This inspecting apparatus includes an unloader portion, a loader portion, an empty tray portion, a heating portion, two sorting portions, an IC socket, a device transfer mechanism, and the like. The first sorting portion, the unloader portion, the loader portion and the empty tray portion are disposed in line in the X-axis directions. Apart from these in the Y-axis directions, the IC socket (i.e., an inspection portion) is disposed. In addition, the second sorting portion and the heating portion are disposed in line away from the first sorting portion and the like in the Y-axis directions.

A device on the loader portion is transferred to the heating portion, using an absorptive pad (hereinafter, referred to as the absorptive nozzle) of the device transfer mechanism (hereinafter, referred to as the part transferring device). Then, the heated device (hereinafter, referred to as the part) is transferred to the IC socket and is inspected. Among the devices which have been inspected, the one which has come up to standard is transferred to the unloader portion, and the one which has not come up to standard is transferred to the first or second sorting portion, respectively, by the device transfer mechanism.

In such an inspecting apparatus, an inspection is given to parts after they have been precisely positioned in a predetermined direction with respect to the inspection portion. This is important to realize firm and precise parts inspections. In this respect, in the apparatus according to the prior art, using a CCD camera which is placed in the part transferring device, parts on the loader portion are imaged before they are inspected, so that their positions or the like can be recognized through those images. Thus, the positions in which they have been absorbed by the absorptive nozzle are corrected in advance, and then, the parts are absorbed and transferred.

However, when parts are absorbed by the absorptive nozzle, they may slip out of place. Or, while they are being transferred, they may be shaken, or such a thing may happen, thereby producing some absorption shifts. Therefore, in the apparatus according to the prior art, parts cannot necessarily be precisely positioned in the inspection portion. Hence, this point needs to be improved. Herein, according to the above described prior art, right before parts are set to the inspection portion, a part can be once placed, and an image of the part can be recognized by a CCD camera. Thus, its position is corrected and it is absorbed again, and then, it is set to the inspection portion. However, even in that case, when a part is absorbed after its image has been recognized, an absorption shift may be produced. Besides, a part has to be absorbed again, which takes an additional time. This would not be a good idea, if it is wished to inspect parts effectively and precisely.

In addition, in the apparatus according to the prior art, the sorting portions or the inspection portion is put in a position which is displaced in the Y-axis directions from the loader portion or the like. Therefore, when the part transferring device transfers parts from the loader portion to the inspection portion, or when it transfers parts from the inspection portion to the unloader portion or the sorting portions (especially, to the side of the heating portion), the absorptive nozzle needs to be largely moved not only in the X-axis directions but also in the Y-axis directions. Hence, the apparatus tends to become larger in the Y-axis directions, thus hindering making such an apparatus smaller. Besides, the absorptive nozzle moves over a long distance in both the X-axis and Y-axis directions. This makes it difficult, for example, to heighten the transfer speed from the viewpoint of control, thus hindering giving inspections effectively.

Disclosure of the Invention

In view of the above described disadvantages, it is an object of the present invention to provide an electronic part inspection apparatus which is capable of inspecting parts effectively and precisely, and to provide such an apparatus whose size is smaller.

In order to attain this object, an electronic part inspection apparatus according to an aspect of the present invention is characterized by including: an inspection portion which inspects a part; a part standby portion in which a part before it is inspected stands by; a part storage portion which stores a part after it is inspected; a part transferring device which has an absorptive nozzle that absorbs a part, and which absorbs a part using this absorptive nozzle, and in that state, transfers the part between the part standby portion or part storage portion and the inspection portion; an image picking-up device which picks up an image of the part that is being transferred by this part transferring device; and a controlling device which transfers a part to the inspection portion, via a position in which the image picking-up device picks up an image of the state where the part is absorbed by the absorptive nozzle while the part is being transferred from the part standby portion to the inspection portion, and based on that picked-up image result, controls the drive of the part transferring device so that the part is set to the inspection portion.

Furthermore, an electronic part inspection apparatus according to another aspect of the present invention, which includes: an inspection portion which inspects a part; a part standby portion in which a part before it is inspected stands by; a part storage portion which stores a part after it is inspected; and a part transferring device which has an absorptive nozzle that absorbs a part, and which absorbs a part using this absorptive nozzle, and in that state, transfers the part between the part standby portion or part storage portion and the inspection portion, wherein the inspection portion, part standby portion and part storage portion are disposed in a line within the range where the absorptive nozzle is moved.

Brief Description of the Drawings

Fig. 1 is a perspective view of an electronic part inspection apparatus according to a first embodiment of the present invention.

Fig. 2 is a top view of the electronic part inspection apparatus according to the first embodiment, seen from the Z-axis directions in Fig. 1.

Fig. 3 is a side view of the electronic part inspection apparatus according to the first embodiment, seen from the X-axis directions in Fig. 1.

Fig. 4 is a front view of the electronic part inspection apparatus according to the first embodiment, seen from the Y-axis directions in Fig. 1.

Fig. 5 is a representation, showing the relation between a tray disposition area and a stocker disposition area.

Fig. 6 is a table, showing an example of the disposition of a tray T in the tray disposition area.

Fig. 7 is an enlarged side view of a stocker.

Fig. 8 is an enlarged front view of the stocker.

Fig. 9 is a representation, showing a movement of the tray T in the stocker.

Fig. 10 is an enlarged top sectional view of an inspection area.

Fig. 11 is an enlarged sectional view of the inspection area.

Fig. 12 is a top view of a part position confirmation camera and an inspection socket, typically showing an example of their disposition.

Fig. 13 is a top view of the part position confirmation camera and the inspection socket, typically showing an example of their disposition.

Fig. 14 is an enlarged top view of a parts transfer mechanism.

Fig. 15 is an enlarged side view of a parts transfer mechanism.

Fig. 16 is a timing chart, showing an operational process of the electronic part inspection apparatus.

Fig. 17 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 18 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 19 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 20 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 21 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 22 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 23 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 24 is a top view of the electronic part inspection apparatus when it operates in the operational process shown in the timing chart of Fig. 16.

Fig. 25 is a top view of an electronic part inspection apparatus according to a second embodiment of the present invention.

Fig. 26 is a top view of an electronic part inspection apparatus according to a third embodiment of the present invention.

Fig. 27 is a top view of another electronic part inspection apparatus according to the third embodiment.

Fig. 28 is a top view of an electronic part inspection apparatus according to a fourth embodiment of the present invention.

Fig. 29 is an enlarged top view of a parts transfer mechanism in the electronic part inspection apparatus according to the fourth embodiment.

Fig. 30 is an enlarged side view of a parts transfer mechanism in the electronic part inspection apparatus according to the fourth embodiment.

Fig. 31 is a top view of an electronic part inspection apparatus according to a fifth embodiment of the present invention.

Fig. 32 is a perspective view of an electronic part inspection apparatus according to a sixth embodiment of the the present invention.

Fig. 33 is a side view of the electronic part inspection apparatus according to the sixth embodiment, seen from the X-axis directions in Fig. 32.

Fig. 34 is a front view of the electronic part inspection apparatus according to the sixth embodiment, seen from the Y-axis directions in Fig. 32.

Fig. 35 is an enlarged side view of a stocker in the electronic part inspection apparatus according to the sixth embodiment.

Fig. 36 is an enlarged front view of the stocker in the electronic part inspection apparatus according to the sixth embodiment.

Fig. 37 is a representation, showing a movement of a tray T in the stocker of the electronic part inspection apparatus according to the sixth embodiment.

Fig. 38 is a side view of an electronic part inspection apparatus according to a seventh embodiment of the present invention.

Fig. 39 is a side view of an electronic part inspection apparatus according to an eighth embodiment of the present invention.

Fig. 40 is a representation, showing a movement of a tray T in the stocker of the electronic part inspection apparatus according to the eighth embodiment.

Fig. 41 is a perspective view of an electronic part inspection apparatus according to a ninth embodiment of the present invention.

Fig. 42 is a top view of the electronic part inspection apparatus according to the ninth embodiment.

Fig. 43 is a side view of a tray movement mechanism, showing its configuration.

Fig. 44 is a perspective view of a wafer movement unit, showing its configuration.

Fig. 45 is a perspective view of a chip-parts taking-out device, showing its configuration.

Fig. 46 is a flow chart, showing an inspection operation in the electronic part inspection apparatus according to the ninth embodiment.

Fig. 47 is a perspective view of another electronic part inspection apparatus according to the ninth embodiment.

Fig. 48 is an enlarged top view and sectional view of an example of a part position adjustment mechanism.

Fig. 49 is a representation, showing the mechanism of a positional adjustment by the part position adjustment mechanism shown in Fig. 48.

Fig. 50 is an enlarged top view and sectional view of another example of the part position adjustment mechanism.

Fig. 51 is a representation, showing the mechanism of a positional adjustment by the part position adjustment mechanism shown in Fig. 50.

Fig. 52 is a representation, showing the relation between an X-axis rail and a part transfer mechanism.

Best Mode for Implementing the Invention

(First Embodiment)

Hereinafter, an electronic part inspection apparatus according to a first embodiment of the present invention will be described in detail with reference to the drawings.

Fig. 1 is a perspective view of an electronic part inspection apparatus 1A according to the first embodiment of the present invention. Figs. 2 to 4 are a top view, a side view and a front view of the electronic part inspection apparatus 1A, seen from the Z, X and Y-axis directions in Fig. 1, respectively.

The electronic part inspection apparatus 1A is an apparatus which transfers and inspects electronic part D. As shown in Figs. 1 to 4, it is configured by combining an electronic part transfer unit 100A which transfers the electronic part D and an electronic part inspection unit 200 which inspects the electronic part D.

Herein, the electronic part inspection apparatus 1A is the electronic part transfer unit 100A which mainly transfers parts to be inspected, before an inspection plate 153 which includes inspection sockets 152a, 152b (described later) is attached, or after the inspection plate 153 has been attached. Or, in addition to the electronic part transfer unit 100A, it is an apparatus which includes the electronic part inspection unit 200 that is a unit related to the inspection control of electronic part. Herein, the electronic part inspection unit 200 is connected via a signal line to the inspection sockets 152a, 152b and a control portion 190 of the electronic part transfer unit 100A, respectively. It executes an inspection of electronic part, and outputs data on the inspection result to the control portion 190 or another portion, or stores it, and in addition, displays it.

Herein, the electronic part D are general electronic part which includes a semiconductor device such as an IC. A tray (mentioned later) is the container according to the present invention.

(Configuration of Electronic Part Transfer Unit 100A)

The electronic part transfer unit 100A is configured mainly by: a base stand 110; two X-axis robots 120 (120a, 120b); a tray disposition area 130 (130a to 130d); a stocker disposition area 140 (140a to 140d); an inspection area 150; a parts transfer mechanism 160 (160a to 160d); an X-directions tray transfer mechanism 170 (170a, 170b); a Y-directions tray transfer mechanism 180 (180a to 180d); the control portion 190; a cover 300; and other components.

Herein, in the above described configuration of the electronic part inspection apparatus 1A, the ones which have an alphabetical affix are each described below without an affix (which is also applied even in the drawings), except the case where they should be distinguished.

The base stand 110 has a substantially rectangular shape at its upper surface, and has a substantially L-shape at its bottom surface. Under the inspection area 150, it has a space 111 which is shaped like a substantially rectangular parallelepiped. In this space 111, the electronic part inspection unit 200 is inserted so as to be connected to the electronic part transfer unit 100A. The space 111 opens on both sides in the X and Y-axis directions, so that the electronic part inspection unit 200 can be inserted even from either side in the X and Y-axis directions.

The X-axis robots 120a, 120b are not shown in detail in the figure, but it is made up of: an X-axis rail which is formed by a fixed magnet; a linear motor which is formed by a movable magnet that can move along this X-axis rail; a screw shaft which is connected to a servo motor; a single screw robot which is formed by a movable nut that is fitted to the screw shaft and the X-axis rail and that can move along this X-axis rail with being stopped from turning; and other components. The X-axis robots 120a, 120b moves the parts transfer mechanisms 160a to 160d in the X-axis directions, and thereby, it transfers the electronic part D. According to this embodiment, the two X-axis robots 120a, 120b are used, thus heightening the efficiency of inspections.

Herein, according to this embodiment, these X-axis robots 120a, 120b configure the track according to the present invention. These X-axis robots 120a, 120b and parts transfer mechanisms 160a to 160d configure the part transferring device according to the present invention. As described above, if the X-axis robots 120a, 120b have the X-axis rail, this X-axis rail can also be regarded as the track according to the present invention.

(Specific Description of Tray Disposition Area 130)

The tray disposition area 130 is set between the X-axis robots 120a, 120b on the base stand 110. It includes four substantially rectangular areas (i.e., the tray disposition areas 130a to 130d) in which trays T1 to T4 are each disposed.

Specifically, as shown in Fig. 5, the tray disposition area 130 is divided into: the tray disposition area 130a (i.e., the part storage portion according to the present invention) in which the tray T1 is disposed that stores, from among the parts that have already been inspected, parts that are up to standard; the tray disposition area 130b (i.e., the part storage portion according to the present invention) in which the tray T2 is disposed that stores, from among the parts that have already been inspected, parts that are below standard; the tray disposition area 130c in which the empty tray T3 is disposed; and the tray disposition area 130d (i.e., the part standby portion according to the present invention) in which the tray T4 is disposed that stores parts that are not yet inspected.

These tray disposition areas 130a to 130d are placed in line in the X-axis directions, together with the inspection sockets 152a, 152b (described later). Hence, the trays T1 to T4 are disposed in line in the X-axis directions. This saves a space in the Y-axis directions (i.e., it makes smaller the electronic part inspection apparatus 1A).

As described later, by the parts transfer mechanism 160, the electronic part D are transferred to the inspection area 150 from the tray T4 of the tray disposition area 130d, and then, they are inspected. On the other hand, by the parts transfer mechanism 160, the electronic part D which have been inspected are transferred from the inspection area 150 to the tray disposition area 130a or 130b. Then, based on their inspection results, they are stored in the tray T1 or T2. If the tray T4 of the tray disposition area 130d becomes empty (i.e., if it becomes the empty tray T3) when the electronic part D are taken out, then by the X-directions tray transfer mechanism 170, this empty tray T3 is transferred from the tray disposition area 130d to the tray disposition area 130c.

The tray disposition area 130 can be suitably set to be longer in the Y-axis directions than the side of each tray T1 to T4 in the Y-axis directions, and shorter than twice its length.

The specific configuration of the trays T1 to T4 is not limited according to the present invention. However, on each of their upper surfaces, a structure (e.g., hollows or protrusions) is formed which is used to sort the electronic part D and place them. In the example shown in the figure, the electronic part D can be stored, ten pieces longitudinally and five pieces laterally.

Herein, the trays T1 to T4 are described below simply as the tray T without any reference number, except the case where they especially need to be distinguished from each other.

(Disposition of Tray T)

Hereinafter, the disposition of the tray T will be described in further detail.

According to this embodiment, as described above, the trays T are arranged in the tray disposition areas 130a to 130d in the order of the trays T1, T2 for parts which have already been inspected, the empty tray T3 and the tray T4 for parts which are not yet inspected. However, this order can be suitably changed. As an example of the disposition of the trays T, dispositions 1 to 3 in Fig. 6 can be considered. Among them, the disposition 1 is a disposition which is already shown according to this embodiment.

According to the dispositions 1 to 3 in Fig. 6, the tray T4 for parts which are not yet inspected is disposed on the side (or on the right-hand side in the figure) of the inspection area 150 from the two trays T1, T2 for parts which have already been inspected. If they are disposed in this way, the electronic part D which are not yet inspected can be prevented from getting mixed into the trays T1, T2 for parts which have already been inspected. In other words, when the electronic part D which are not yet inspected are transferred to the inspection area 150, they will not pass through the trays T1, T2 for parts which have already been inspected. Therefore, even if the electronic part D which are not yet inspected drop from the parts transfer mechanism 160, they will not get mixed into the trays T1, T2 for parts which have already been inspected.

In addition, according to the disposition 1 in Fig. 6, the empty tray T3 is disposed between the trays T1, T2 for parts which have already been inspected and the tray T4 for parts which are not yet inspected. Therefore, there is an advantage in that the empty tray T3 can be quickly moved between the disposition area 130d of the tray T4 for parts which are not yet inspected and the disposition areas 130a, 130b of the trays T1, T2 for parts which have already been inspected, and the disposition area 130c of the empty tray T3. Herein, such a movement of the tray T3 is made using the X-directions tray transfer mechanism 170.

Herein, if there is no problem in that the electronic part D may drop from the parts transfer mechanism 160, in the dispositions shown in Fig. 6, the disposition of the tray T4 for parts which are not yet inspected and the disposition of the trays T1, T2 for parts which have already been inspected may also be switched. Even in either case, the distance by which the electronic part D are transferred remains unchanged, thereby keeping the speed of inspections at the same level.

With respect to the two trays T1, T2 for parts which have already been inspected, which of them should be disposed in the tray T1 for up-to-standard parts or the tray T2 for below-standard parts, in other words, which of the trays T1, T2 should be disposed on the side of the inspection area 150, may be determined according to the yield of an inspection.

Generally, such a yield is 50% or higher, and thus, if the tray T1 for up-to-standard parts is placed closer to the inspection area 150 than the tray T2 for below-standard parts is, the speed of inspections can be heightened.

In contrast, if the yield is lower than 50%, the tray T2 for below-standard parts should be placed closer to the inspection area 150 than the tray T1 for up-to-standard parts is. This is advantageous to make the speed of inspections higher.

According to such a yield, the number of the required trays T1 for up-to-standard parts is different from that of the required trays T2 for below-standard parts. Usually, the yield is 50% or higher, and consequently, the number of the trays T1 for up-to-standard parts becomes larger.

The tray T1 to T4 of each tray disposition area 130a to 130d is moved independently of each other in the Y-axis directions, by the Y-directions tray transfer mechanism 180 (described later). Therefore, even if the parts transfer mechanism 160 is not moved (i.e., if it is given little or no movement) in the Y-axis directions, the electronic part

D can be attached and detached at a desirable place inside of the trays T1 to T4. In other words, all the electronic part D which are stored in the tray T can be inspected, and the already-inspected electronic part D can be stored in all the storage places of the tray T. Hence, the whole tray T can be used efficiently, thus reducing the number of the trays T which are prepared according to the number of the electronic part D.

Furthermore, the movement of the electronic part D by the parts transfer mechanism 160 and the movement of the tray T by the Y-directions tray transfer mechanism 180 can be made at the same time. This makes the speed of inspections higher (i.e., it makes an inspection more efficient).

The tray T is also moved when all the electronic part D have been transferred from the tray for not-yet-inspected parts, and when the already-inspected electronic part D have filled the tray for already-inspected parts. In other words, the tray T4 for not-yet-inspected parts which has become empty is moved to the tray disposition area 130c of the empty tray T3. Then, by the Y-directions tray transfer mechanism 180, the tray T1 (or the tray T2) for already-inspected parts which is full of the electronic part D is sent out to the stocker disposition area 140 (described later).

Thereafter, the empty tray T3 on the tray disposition area 130c is moved to the tray disposition area 130a (or 130b) for already-inspected parts. This movement is made by the X-directions tray transfer mechanism 170, but it may also be conducted using an absorption head 165 (described later). In such a case, the absorption head 165 transfers the electronic part D and also transfers the tray T. This reduces production costs for the apparatus (i.e., it makes it possible to omit the X-directions tray transfer mechanism 170)

(Specific Description of Stocker Disposition Area 140)

Fig. 5 shows the relation between the tray disposition area 130 and the stocker disposition area 140 (described later). As shown in this figure, the stocker disposition area 140 is disposed along the X-axis robot 120b, and it is divided into the four stocker disposition areas 140a to 140d which correspond to the above described tray disposition areas 130a to 130d.

In each stocker disposition area 140a to 140d, stocker disposition areas 141a to 141d are disposed which can store the trays T which are piled. Specifically, four openings are formed along the X-axis robot 120b on the base stand 110, and in these openings, the stocker disposition areas 141a to 141d are each disposed so as to be attached and detached.

Among these stockers 141 (or the stockers 141a to 141d), the stockers 141a, 141b are stockers for already-inspected parts (e.g., for up-to-standard parts and for below-standard parts, respectively) which store the trays T1, T2, respectively. The stocker 141c is an empty-tray storage stocker which stores the tray T3. The stocker 141d is a stocker for not-yet-inspected parts which stores the tray T4.

As described already, the stocker disposition area 140 is divided into: the stocker disposition areas 140a, 140b for already-inspected parts trays; the stocker disposition area 140c for empty trays; and the stocker disposition area 140d for not-yet-inspected parts trays. The stockers 141a to 141d are each disposed in these division areas. The division areas correspond to the tray disposition areas 130a to 130d, respectively.

In this way, each stocker 141 stores a predetermined tray T so that it corresponds to the division areas of the tray disposition area 130. Thus, the tray T can be efficiently transferred between it and the tray disposition area 130. Herein, according to this embodiment, the above described stockers 141a to 141d which are disposed in the stocker disposition area 140 each configures the container storage portion according to the present invention.

Fig. 7 and Fig. 8 are a side view and a front view of the stocker 141 (141a to 141d).

With respect to the stockers 141a to 141d, the tray T which they each store has a different role, but their configurations are the same. Therefore, the stockers 141a to 141d are described below without an affix (which is also applied even in the drawings), except the case where they should be distinguished.

The stocker 141 is configured by four struts 143, a bottom portion 144, four tray separation hooks 145, and a tray lift mechanism 146. Inside of it, a tray-transfer-mechanism entry region 147 is formed which the Y-directions tray transfer mechanism 180 (described later) enters. Among these, the struts 143, the tray separation hooks 145 and the tray-transfer-mechanism entry region 147 are disposed above the upper surface of the base stand 110. The bottom portion 144 and the tray lift mechanism 146 are disposed below the upper surface of the base stand 110.

The strut 143 is connected to a member which is connected to the base stand 110 and is a pillar which has a substantially L-shape section. It corresponds to each of the four corners of the tray T and prevents the tray T from moving in the two-axis directions of X-Y.

The bottom portion 144 is connected to the struts 143, and is configured by a bottom plate which has a substantially rectangular shape, and four side plates. Herein, these side plates may also be excluded, and in that case, the struts 143 are connected directly to the bottom plate which is the bottom portion 144.

Herein, the stocker 141 has, at its front (i.e., in the figure, right-hand) wall, a door which can be opened and closed. Thus, the tray T can be easily inserted into, and carried out from, the stocker 141. A ceiling portion 142 cannot be detached and attached as the ceiling of the stocker 141. However, in the case where the tray T is, from above the stocker 141, inserted into and carried out from the stocker 141, it can be detached and attached.

The tray separation hooks 145 are disposed in the member which the four struts 143 are connected to. They are disposed on the opposite sides to each other of the lowermost tray T inside of the stocker 141. Specifically, a concave portion is formed on each opposite side of the tray T, and the tray separation hook 145 is inserted into the concave portion of the tray T. This prevents the lowermost tray T from dropping downward (i.e., in the Z-minus direction). To the tray separation hooks 145, a drive mechanism (not shown) is connected, and the tray separation hooks 145 are inserted into the concave portions on the sides of the tray T and are taken out from them. Through these insertion and taking-out, the tray T is fixed and removed in the Z-minus direction.

The tray lift mechanism 146 moves up and down a flat plate (or a tray placement plate) which the tray T is placed on. It is a mechanism which lifts and lowers the tray T in the stocker 141.

The tray lift mechanism 146 can move up and down the tray placement plate, in a state where the Y-directions tray transfer mechanism 180 in which the tray T is not placed is located inside of the tray-transfer-mechanism entry region 147. In addition, the Y-directions tray transfer mechanism 180 has, on its tray side, a part which is cut off into a substantially U-shape. Therefore, while the tray lift mechanism 146 is raising the tray placement plate, the Y-directions tray transfer mechanism 180 in which the tray T is not placed can be moved into the tray-transfer-mechanism entry region 147. Hence, the tray placement plate of the tray lift mechanism 146 can be lifted ahead, thereby shortening the time necessary for carrying out the tray T from the stocker 141.

The tray-transfer-mechanism entry region 147 is a space which has a substantially rectangular parallelepiped shape. It is located above the upper surface of the base stand 110 and below the tray separation hooks 145. The Y-directions tray transfer mechanism 180 goes into it and comes out of it, from the Y-Plus direction.

The movement of the tray T from the inside of the stocker 141 to the tray disposition area 130 is made in the following process. Herein, an operation for the movement of the tray T inside of the stocker 141 is described using Fig. 9.

(1) The tray lift mechanism 146 operates to lift the tray placement plate. Then, if the tray placement plate comes into contact with the bottom surface of the lowermost tray T in the stocker 141, the tray separation hooks 145 are removed (i.e., the tray separation hooks 145 are taken out from the inside of the concave portions on the sides of the tray T) (see Fig. 9A).

(2) The tray lift mechanism 146 operates to move down the

tray placement plate by the height of one tray T. Then, the second tray from the bottom is set to a height position which corresponds to the tray separation hooks 145.

(3) The tray separation hooks 145 operate to fix the second tray T from the bottom (i.e., the tray separation hooks 145 are inserted into the concave portions on the sides of the second tray T from the bottom) (see Fig. 9B).

(4) The tray lift mechanism 146 operates to move down the lowermost tray T together with the tray placement plate. At this time, the second tray T from the bottom is fixed to the tray separation hooks 145.

(5) The tray placement plate moves down further so that the lowermost tray T comes to a height position which corresponds to the tray-transfer-mechanism entry region 147. At this time, in advance, the Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 147 and stays there.

As a result, the tray T on the tray lift mechanism 146 descends onto the Y-directions tray transfer mechanism 180 inside of the tray-transfer-mechanism entry region 147, and is placed there (see Fig. 9C).

The tray T which has been placed on the Y-directions tray transfer mechanism 180 remains and is held on the Y-directions tray transfer mechanism 180, even if the tray placement plate goes down further. In this way, the tray T placed on the tray lift mechanism 146 is transferred to the Y-directions tray transfer mechanism 180.

(6) The Y-directions tray transfer mechanism 180 retreats from the tray-transfer-mechanism entry region 147, and thus, the tray T which is placed on the Y-directions tray transfer mechanism 180 is carried out from the stocker 141 and is place in the tray disposition area 130.

The movement and placement of the tray T from the tray disposition area 130 to the stocker 141 are made in the following way.

(1) In the state where the tray T is placed on the Y-directions tray transfer mechanism 180, the Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 147 from the tray disposition area 130. Thereby, the tray T is transferred into the stocker 141 (see Fig. 9C).

(2) The tray lift mechanism 146 operates to move up the tray placement plate. As a result, the tray T which is placed on the Y-directions tray transfer mechanism 180 is transferred to the tray lift mechanism 146 (i.e., the tray placement plate).

The tray placement plate of the tray lift mechanism 146 ascends further, and the placed tray T is moved up to a height position in which it comes into contact with the bottom surface of the lowermost tray T inside of the stocker 141 (see Fig. 9B).

(3) In the state where the tray T stays in contact by the tray lift mechanism 146, the tray separation hooks 145 are

removed (i.e., the tray separation hooks 145 are taken out from the inside of the concave portions on the sides of the tray T).

(4) The tray lift mechanism 146 operates to move up the tray placement plate by the height of one tray T. Then, the tray T which is placed on the tray lift mechanism 146 is brought to a height position which corresponds to the tray separation hooks 145 (see Fig. 9A).

(5) The tray separation hooks 145 operate to fix the tray T which is placed on the tray lift mechanism 146.

In this way, the tray T on the tray disposition area 130 is stored and fixed in the lowermost part inside of the stocker 141.

(6) Thereafter, the tray placement plate of the tray lift mechanism 146 descends. At this time, the lowermost tray T of the stocker 141 is fixed to the tray separation hooks 145. Thus, even if the tray placement plate goes down, the tray T remains held inside of the stocker 141. The tray placement plate of the tray lift mechanism 146 moves down below the tray-transfer-mechanism entry region 147.

In such a way as described above, the tray T on the tray disposition area 130 is stored and fixed in the lowermost part inside of the stocker 141.

Hence, the stockers 141a to 141d store the trays T such that they are piled on top of one another, thus making it easier to exchange the tray T. In other words, the trays

T are piled up above the tray-transfer-mechanism entry region 147, and thereby, the lowermost tray T of the stocker 141 is easily transferred to, and carried out from, the tray-transfer-mechanism entry region 147. Besides, the distance between the tray-transfer-mechanism entry region 147 and the tray disposition area 130 is the same in any of the stockers 141. Thus, the time during which the tray T is transferred between them is uniform, thereby helping make the speed of inspections higher.

(Specific Description of Inspection Area 150)

The inspection area 150 is located between X-axis robots 120a, 120b, and is a substantially rectangular area which is set on the line along which the tray disposition area 130 extends in the X-axis directions. Below it, the electronic part inspection unit 200 is disposed.

Fig. 10 and Fig. 11 are a top view and a sectional view of the inspection area 150, respectively. As shown in these figures, in the inspection area 150, there are disposed two part position confirmation cameras 151a, 151b which configure the image picking-up device according to the present invention, and the two inspection sockets 152a, 152b which are the inspection portion according to the present invention. The part position confirmation cameras 151a, 151b are placed on the base stand 110. The inspection sockets 152a, 152b are placed on the inspection plate 153, and via the inspection plate 153, are set to the base stand 110 so that they can be attached and detached. Herein, these part position confirmation cameras 151a, 151b and inspection sockets 152a, 152b are each described below without an affix (which is also applied even in the drawings), except the case where they should be distinguished.

The part position confirmation cameras 151a, 151b are image picking-up cameras which are used to confirm the position (i.e., the absorption state) of the electronic part D which are transferred by the parts transfer mechanism 160. They are configured by a line sensor, a CCD camera, a vision camera and the like. Their configuration is not limited especially, as long as two-dimensional image information (or in some cases, in a one-axis directions) of the electronic part D can be obtained.

The part position confirmation cameras 151a, 151b are placed, along the Y-axis directions on the inspection area 150 and in line symmetrically with respect to the Y-axis directions. They each pick up the image of the electronic part D which pass over them. The picked-up image is processed, and thus, the position of the electronic part D with respect to the parts transfer mechanism 160 is detected. As a result, when the electronic part D are absorbed at the parts transfer mechanism 160, the positional shift (in the X, Y and R-axis directions) of the electronic part D is detected. Thus, when the electronic part D are connected to the inspection socket 152, the position of the electronic part D is corrected, thereby making such a connection more certain. In other words, the electrodes of the electronic part D can be more certainly brought into contact with, and connected to, the electrodes of the inspection socket 152.

The part position confirmation cameras 151a, 151b can also be used to inspect the outside appearance of the electronic part D. In the same way as the case where the position of the electronic part D is confirmed, this inspection is given when the parts transfer mechanism 160 which has absorbed the electronic part D passes over the part position confirmation cameras 151a, 151b. In this way, the electronic part inspection apparatus 1A can inspect not only the electronic part D electrically, but also its outside appearance easily. Besides, if a code is shown on the surface of the electronic part D, such a code can be read using the part position confirmation cameras 151a, 151b. This makes it possible to judge their types from the electronic part D themselves (i.e., it makes an inspection multifunctional).

The inspection sockets 152a, 152b are electrically connected to both the electronic part D and the electronic part inspection unit 200. Thus, it is an electric connection member which allows the electronic part inspection unit 200 to inspect the electronic part D electrically.

The inspection sockets 152a, 152b are disposed in line in the X directions with respect to the Y-axis directions over the inspection area 150. The inspection plate 153 is a substantially flat plate which the inspection sockets 152a, 152b are connected to, and it can be attached to and detached from the base stand 110.

Herein, in the inspection area 150, the disposition of the part position confirmation camera 151 and the inspection socket 152 will be described in detail.

According to this embodiment, the number of the part position confirmation cameras 151 and the inspection sockets 152 is two, respectively, and the inspection sockets 152 are arrange in the Y-axis directions. However, these number and disposition can also be changed.

Fig. 12 and Fig. 13 are top views of the part position confirmation camera 151 and the inspection socket 152, typically showing an example of their disposition. Fig. 12 shows the case where the number of the part position confirmation cameras 151 is two, and Fig. 13 shows the case where the number of the part position confirmation cameras 151 is one.

As shown in A to C of Fig. 12 and Fig. 13, in examples of the disposition of the part position confirmation camera 151 and the inspection socket 152, the number of the part position confirmation cameras 151 is one or two, and the number of the inspection sockets 152 is two or four. Among these combinations, Fig. 12A corresponds to the disposition according to this embodiment shown in Fig. 10.

The more inspection sockets 152 are used, the more easily a great number of the electronic part D can be inspected at the same time and in parallel. Besides, if a plurality of the part position confirmation cameras 151 are provided, the position of several such electronic part D can be confirmed simultaneously.

It is preferable that these number and disposition be suitably selected according to the number or disposition of the parts transfer mechanisms 160. According to this embodiment, the inspection sockets 152 are disposed in the directions which extend in the X-axis directions in a substantially middle of the tray T. This makes it possible to shorten the distance by which the parts transfer mechanism 160 moves in the Y-axis directions.

The direction in which the inspection plate 153 is attached to the base stand 110 is kept fixed. The attachment types of two types of the inspection plates 153 in A, B of Fig. 12, Fig. 13 are attached are supposed to be recognized using an inspection-position confirmation camera 154 (described later), or inputted in the control portion 190 using an input unit (not shown).

Herein, as shown in A, B of Fig. 12, Fig. 13, the direction in which the inspection plate 153 is attached may also be changed. In that case, the direction in which the inspection sockets 152 are arranged in line is changed from the X-axis directions to the Y-axis directions.

The direction in which the inspection sockets 152a, 152b are attached can be detected (i.e., the direction in which the inspection plate 153 is attached can be detected), by recognizing their images using the inspection-position confirmation camera 154, or by inputting data. However, according to this embodiment, as shown in Fig. 10, Fig. 11, it is detected by forming an opening portion 155 in the inspection plate 153 and forming, in the base stand 110, an opening detection portion 156 which corresponds to this opening portion 155. In other words, the opening portion 155 is detected by the opening detection portion 156, and based on whether is detected or not, the direction in which the inspection plate 153 is attached can be detected.

As the opening detection portion 156, for example, an optical sensor can be used. Specifically, for example, as shown in Fig. 11, above the opening detection portion 156, a light emitting portion 157 is provided. Based upon whether or not the light which is emitted from the light emitting portion 157 and goes toward the opening detection portion 156 is shielded by the inspection plate 153, the direction in which the inspection plate 153 is attached can be detected.

In addition, the opening detection portion 156 may also be configured by a limit switch. In that case, the opening portion 155 can be detected using the ON, OFF of the limit switch. If the opening portion 155 is located on the limit switch, the limit switch is turned OFF. If the opening portion

155 does not come onto the limit switch, the limit switch is pressed by the inspection plate 153, and it is turned ON. Herein, at this time, there is no need to configure the opening portion 155 as a hole which penetrates the inspection plate 153. It is enough that it is a concave portion which the tip of the limit switch can be inserted into.

(Specific Description of the Parts Transfer Mechanism 160)

The parts transfer mechanism 160 (160a to 160d) is used to absorb and transfer the electronic part D. Herein, the parts transfer mechanisms 160a, 160b are placed in the X-axis robot 120a, and the parts transfer mechanisms 160c, 160d are placed in the X-axis robot 120b. In this way, the parts transfer mechanisms 160a, 160b and the parts transfer mechanisms 160c, 160d are placed in the different X-axis robots 120a, 120b, respectively. Thereby, the electronic part D can be transferred independently of each other in the X-axis directions, thus heightening the efficiency of inspections of the electronic part D.

Fig. 14 and Fig. 15 are an enlarged top view and side view of the parts transfer mechanism 160, respectively. As shown in these figures, each parts transfer mechanism 160 is configured by: an X-directions drive portion 161; a Y-directions drive portion 162; a Z-directions drive portion 163; an R-directions drive portion 164; the absorption head 165; and an absorptive nozzle 166.

Among the four parts transfer mechanisms 160a to 160d, in the parts transfer mechanisms 160a, 160c on the side of the tray disposition area 130, the X-directions tray transfer mechanisms 170a, 170b are provided, respectively. To an absorption head 165b of the parts transfer mechanism 160b on its opposite side, the inspection-position confirmation camera 154 is connected.

The X-directions drive portion 161 moves in the X-axis directions on the X-axis robot 120, thereby allowing the absorption head 165 to move in the X-axis directions.

The Y-directions drive portion 162 is connected to the X-directions drive portion 161, and is configured by a Y-directions drive base body 1621 and a Y-directions drive body 1622.

The Y-directions drive body 1622 is expanded and contracted in the Y-axis directions with respect to the Y-directions drive base body 1621, so that the absorption head 165 can be moved in the Y-axis directions. If the parts transfer mechanisms 160a, 160b come close to the parts transfer mechanisms 160c, 160d in the X-axis directions, then the Y-directions drive portion 162 allows the absorption head 165 to move in the Y-axis directions. Thereby, they can be prevented from interfering (or coming into contact) with each other.

The Z-directions drive portion 163 is connected to the end part of the Y-directions drive body 1622, and is configured by a Z-directions drive base body 1631 and a

Z-directions drive body 1632. The Z-directions drive body 1632 is moved up and down in the Z directions with respect to the Z-directions drive base body 1631, so that the absorption head 165 can be moved in the Z directions.

Herein, such an up-and-down movement in the Z directions can also be made, like the Y-directions drive portion 162, using a ball screw, ball nut mechanism, or a drive body such as a hydraulic cylinder mechanism and a linear motor mechanism. Conversely, in the Y-directions drive portion 162, like the Z-directions drive portion 163, based upon a shift in movement between members, the absorption head 165 can be moved in the Y-axis directions.

The R-directions drive portion 164 is connected to the upper end of the Z-directions drive body 1632, and is used to allow the absorption head 165 to rotate (i.e., rotate in the R directions: rotate in the right and left directions on the X-Y plane) on the Z axis.

The absorption head 165 is configured by a head body 1651, and an absorptive-nozzle support member 1652. The head body 1651 is connected to the lower end of the Z-directions drive body 1632. It can be moved independently in the X-axis, Y-axis and Z directions by the X-directions drive portion 161, the Y-directions drive portion 162 and the Z-directions drive portion 163, respectively.

The absorptive-nozzle support member 1652 is connected to the lower end of the head body 1651, and supports the absorptive nozzle 166. The absorptive-nozzle support member 1652 rotates with respect to the head body 1651, using the R-directions drive portion 164.

Herein, at the time of these movements, the X-directions drive portion 161, the distance by which the Y-directions drive portion 162, the Z-directions drive portion 163 and the R-directions drive portion 164 are moved is detected, using an encoder and the like. Then, its feedback to the control portion 190 is executed, thus making their control more proper.

The absorptive nozzle 166 is connected to the absorption head 165 so that it can be attached and detached. Inside of its tip, a negative or positive air pressure is produced using an absorptive mechanism (not shown). Thereby, it can absorb, releases (i.e., attaches), or holds an attachment of, the electronic part D. The absorption head 165 may also be replaced and used according to the shape of the electronic part D.

The absorptive nozzle 166 is connected to the absorption head 165, and thus, it moves in the X, Y and Z directions and rotates on the R axis, along with each movement of the X-directions drive portion 161, the distance by which the Y-directions drive portion 162, the Z-directions drive portion 163 and the R-directions drive portion 164.

The inspection-position confirmation camera 154 is placed on the side of the absorption head 165b. In the case where there is an identification code on the inspection socket 152, the tray T and the inspection plate 153, it can pick up, from above, the image of this identification code. The inspection-position confirmation camera 154 is configured by a line sensor, a CCD camera, a vision camera and the like. Its configuration is not limited especially, as long as two-dimensional image information (or in some cases, in a one-axis directions) of the electronic part D can be obtained. The picked-up image is processed, and thus, the position of the inspection socket 152 or the tray T, and the identification code, are detected.

Herein, the inspection-position confirmation camera 154 can placed in each of the parts transfer mechanisms 160a to 160d. In this case, the position of the electronic part D which are not yet inspected on the tray T can be confirmed, using the inspection-position confirmation camera 154. Then, Based on the confirmed position, the position of the absorptive nozzle 166 can be corrected. According to this configuration, when the electronic part D are absorbed, a shift in the position (i.e., in the X, Y and Z directions) of the electronic part D with respect to the absorptive nozzle 166 is kept down. Thereby, when the electronic part D are absorbed by the absorptive nozzle 166, the absorption quality can be prevented from deteriorating, thus heightening the efficiency of inspections.

Furthermore, the position of the inspection socket

152 is confirmed, and when the electronic part D are connected (or attached) to the inspection socket 152, the position of the electronic part D can be corrected. As a result, when the electronic part D are attached to the inspection socket 152, the attachment quality can be prevented from deteriorating, thus making an inspection more certain.

(Specific Description of the Tray Transfer Mechanism 170)

As shown in Fig. 14 and Fig. 15, the X-directions tray transfer mechanism 170 (170a, 170b) is configured by a Z-directions tray drive portion 171, and a tray absorption portion 172.

The Z-directions tray drive portion 171 is connected to the Y-directions drive base body 1621. It can be moved in the X-axis directions by the X-directions drive portion 161, and moves up and down the tray absorption portion 172.

The tray absorption portion 172 is a flat plate which can be moved in the X and Z directions by the X-directions drive portion 161 and the Z-directions tray drive portion 171. In its lower surface, there are formed one or several absorption holes (not shown). The tray absorption portion 172 is connected to an absorption mechanism (not shown). It absorbs air from the absorption hole and stops absorbing it, so that the tray T can be absorbed and released. Herein, the absorption and release of the tray T by the tray absorption portion 172 and the absorption and release of the electronic part D by the absorptive nozzle 166 can be conducted independently of each other.

Using the X-directions tray transfer mechanism 170, the tray T on the tray disposition area 130 can be transferred. This transfer is conducted in such a way as described below.

(1) The X-directions drive portion 161 moves the tray absorption portion 172 in the X-axis directions and brings it above the tray T to be transferred.

(2) The Z-directions tray drive portion 171 moves down the tray absorption portion 172, and allows its lower surface to come into contact with, or come close to, the upper surface of the tray T to be transferred.

(3) The tray absorption portion 172 is operated so that the tray absorption portion 172 absorbs the tray T.

(4) The Z-directions tray drive portion 171 moves up the tray absorption portion 172. The tray T which has been absorbed by the tray absorption portion 172 goes up together with the tray absorption portion 172.

(5) The X-directions drive portion 161 moves the tray absorption portion 172 which has absorbed the tray T onto a transfer target position in the X-axis directions.

(6) The Z-directions tray drive portion 171 moves down the tray absorption portion 172 which has absorbed the tray T, and allows the lower surface of the tray T to come into contact with, or come close to, the tray disposition area 130.

(7) The absorption of the tray T by the tray absorption portion 172 is removed (or released), and the Z-directions tray drive

portion 171 moves up the tray absorption portion 172. As a result, the tray T which has been released from the tray absorption portion 172 remains at the place up to which it has been transferred.

This transfer of the tray T in the X-axis directions is used, for example, in the case where, when the electronic part D are carried out from the tray T4 for parts which are not yet inspected and then the tray becomes empty, this empty tray is transferred to the position of the tray T3 (i.e., the tray disposition area 130c).

In addition, it is used in the case where, when the electronic part D which have already been inspected fills the trays T1, T2 for parts which have already been inspected, instead of these trays T1, T2, the empty tray T3 is transferred to the position of the trays T1, T2 (i.e., the tray disposition areas 130a, 130b) as a new tray for already-inspected parts. Herein, the trays T1, T2 for already-inspected parts which are full of the already-inspected electronic part D are transferred to the inside of the stocker 141 by the Y-directions tray transfer mechanism 180.

(Specific Description of Y-directions Tray Transfer Mechanism 180)

The Y-directions tray transfer mechanism 180 (180a to 180d) is a mechanism which transfers the tray T in the Y-axis directions between the trays T1 to T4 and the stockers 141a to 141d. As shown in Fig. 7 and Fig. 8, it is configured by: a shaft 181; a movement portion 182; a tray placement portion 183; and a pair of tray fixing portions 184.

The shaft 181 is a ball screw which is a substantially cylindrical pole with a screw thread. It is disposed along the directions from the tray disposition area 130 to the stocker disposition area 140 (specifically, the tray-transfer-mechanism entry region 147 inside of the stocker 141). The shaft 181 is connected to a rotation mechanism which is made up of a servo motor (not shown). When this rotation mechanism operates, the shaft 181 rotates on its axis. Herein, when it rotates, the operational quantity of the rotation mechanism is detected, using an encoder and the like. Then, its feedback to the control portion 190 is executed, thus making such control more proper.

The movement portion 182 is shaped like a substantially flat plate, and has a ball nut portion. This ball nut portion is penetrated by the shaft 181. When the shaft 181 rotates, the ball screw of the shaft 181 engages with the ball nut of the movement portion 182, and thereby, the movement portion 182 moves forward and backward along the axis of the shaft 181.

The tray placement portion 183 is formed by a substantially rectangular flat plate, and on it, the tray T is placed. The tray placement portion 183 is connected, at its lower surface near one of its ends, to a side of the movement portion 182. It moves together with the movement portion 182 along the axis of the shaft 181.

The tray fixing portions 184 are each disposed at the four sides on the upper side of the tray placement portion 183. They are each formed by a rod member which has a substantially rectangular section. Among the four-side tray fixing portions 184, at least one of the two sides in the X-axis directions can be moved in the X-axis directions, using a movement unit (not shown). Consequently, the interval of the tray fixing portions 184 in the X-axis directions can be suitably controlled. The tray T on the tray placement portion 183 can be pressed and fixed on both sides.

Furthermore, among the four-side tray fixing portions 184, at least one of the two sides in the Y-axis directions may also be moved in the Y-axis directions, using a movement unit (not shown). In that case, the tray T which is different in size in the Y-axis directions can be transferred.

The Y-directions tray transfer mechanism 180 can be used in the case where the tray T is moved from the stocker 141 to the tray disposition area 130, or vice versa. In addition to this, the Y-directions tray transfer mechanism 180 moves the tray T inside of the tray disposition area 130, thus shortening the distance by which the absorption head 165 moves in the Y-axis directions. At this time, each tray T can be moved independently or in one body.

According to this embodiment, the Y-directions tray transfer mechanism 180 configures the container moving device and container transferring device according to the present invention. In other words, by this Y-directions tray transfer mechanism 180, the container moving device is configured, and in addition, the Y-directions tray transfer mechanism 180 is configured to have the function of the container transferring device according to the present invention.

Herein, in the electronic part inspection apparatus 1A, as described above, the Y-directions tray transfer mechanism 180 is provided. As a result, the parts transfer mechanism 160 takes out or puts the electronic part D from or into the tray T of the tray disposition area 130, without giving little or no movement to the absorptive nozzle 166 in the Y-axis directions.

(Specific Description of Control Portion 190)

The control portion 190 is disposed in the base stand 110, and is configured by: a CPU 191; 1 an ROM 192; an RAM 193; a communication controller 194; an I/O controller 195; a motion controller 196; an image controller 197; and the like. It controls the drive of the electronic part transfer unit 100A, and communicates with a control portion (not shown) of the electronic part inspection unit 200.

Based upon software which is stored in the ROM 192 and RAM 193, the control portion 190 controls the drive of the electronic part transfer unit 100A and communicates with the electronic part inspection unit 200, through the communication controller 194, I/O controller 195, motion controller 196 and image controller 197. The software transfers the electronic part D and the tray T, according to a combination of the electronic part D to be inspected and the inspection socket 152, and a signal from the electronic part inspection unit 200. The electronic part inspection unit 200 conducts an inspection based on the software of inspection contents which correspond to the electronic part D. Herein, according to this embodiment, this CPU 191 functions as the controlling device which controls the drive of the part transferring device, and as the collision-prevention controlling device.

The ROM 192 and RAM 193 are each a storing means which stores fixed and temporary information. They store, for example, software which represents an operational process and contents of the electronic part transfer unit 100A, information which represents a situation of the electronic part transfer unit 100A, or the like. This information includes information on parts absorption at the time when the absorption head 165 has absorbed the electronic part D on the tray T, information on parts attachment at the time when the electronic part D have been attached to the inspection socket 152, or the like. Such information is referred to when the absorption head 165 absorbs and releases the electronic part D, thereby eliminating malfunctions more certainly.

The ROM 192 and RAM 193 also store information on an attachment direction of the inspection socket 152 which the I/O controller 195 has received from the opening detection portion 156, and software for rotating or moving the absorption head 165 in response to this attachment direction. In other words, the absorption head 165 is rotated or moved so as to correspond to the inspection socket 152, so that the electronic part D can be firmly attached to the inspection socket 152. Herein, in order to heighten the efficiency of inspections (i.e., in order to prevent the speed of inspections from being reduced), it is preferable that the absorption head 165 be rotated while the absorption head 165 is moving.

The communication controller 194 communicates with the electronic part inspection unit 200. It outputs, to the electronic part inspection unit 200, for example, information on whether the electronic part D are properly placed in the inspection socket 152, or further, information on types of the electronic part D. It inputs, from the electronic part inspection unit 200, information on inspection results of the electronic part D by the electronic part inspection unit 200. It also inputs and outputs information on a unit state which represents a state of the electronic part transfer unit 100A, or the like. Hence, when the electronic part D are transferred and inspected, information is exchanged between the electronic part transfer unit 100A and the electronic part inspection unit 200.

The communication between the communication controller 194 (i.e., the electronic part transfer unit 100A) and the electronic part inspection unit 200 can be conducted by various methods, such as wire and radio. For example, if an operator connects a signal coupler, communication can be conducted between the electronic part transfer unit 100A and the electronic part inspection unit 200. In addition, when the electronic part inspection unit 200 is inserted in the space 111 under the electronic part transfer unit 100A, signal couplers of both the electronic part inspection unit 200 and the electronic part transfer unit 100A may also be automatically connected.

The I/O controller 195 and the motion controller 196 are each connected to the parts transfer mechanism 160, the X-directions tray transfer mechanism 170, the Y-directions tray transfer mechanism 180, and a drive unit (not shown) which drives the stocker 141. Herein, this drive unit is connected to the X-directions drive portion 161, the Y-directions drive portion 162, the Z-directions drive portion 163, the R-directions drive portion 164, or the like.

The I/O controller 195 inputs, from the parts transfer mechanism 160 or the like, state information on its state. The motion controller 196 outputs, to the parts transfer mechanism 160 or the like, an operation command on the contents of an operation.

Consequently, control or the like is executed of the absorption, release and transfer of the electronic part D by the parts transfer mechanism 160, the absorption, release and transfer of the tray T by the X-directions tray transfer mechanism 170, the fixing, fixing removal and transfer of the tray T by the Y-directions tray transfer mechanism 180, the transfer of the tray T to and from the stocker 141, or the like.

In addition, the I/O controller 195 receives, from the opening detection portion 156, information on the direction in which the inspection socket 152 is attached. This information is used to rotate or move the absorption head 165 so that it corresponds to the inspection socket 152, and thereby, to allow the electronic part D to be certainly attached to the inspection socket 152.

The image controller 197 is connected to the part position confirmation cameras 151a, 151b and the inspection-position confirmation camera 154. It outputs an image pick-up command which is used to command these to pick up an image, inputs the result of an picked-up image (i.e., image information) from these, or conducts such an operation. The picked-up image information is processed by the CPU 191. Consequently, the position of the absorption head 165, the position of the electronic part D with respect to the absorption head 165, the position of the inspection socket 152 or the tray T, the position of the electronic part D with respect to the inspection socket 152 or the tray T, and the like, are detected.

Herein, a control portion (not shown) on the side of the electronic part inspection unit 200 which controls an input and an output of a signal for inspecting an electronic circuit, and the control portion 190 which mainly controls the side of the electronic part transfer unit 100A, may also be united. In that case, they are disposed on the side of the electronic part inspection unit 200, or they are disposed on the side of the electronic part transfer unit 100A.

(Specific Description of Electronic part Inspection Unit 200)

The electronic part inspection unit 200 is electrically connected to the inspection socket 152, and inspects the electronic part D electrically.

In the electronic part inspection unit 200, a measuring device and the like are provided which inspect the electronic part D. These measuring devices are electrically connected to the inspection socket 152. As a result, the electronic part inspection unit 200 can inspect the electronic part D via the inspection socket 152.

The electronic part inspection unit 200 is configured to be inserted into the space 111 of the base stand 110, even from either of the two X and Y directions. This is because the space 111 is opened in the two directions on the sides of the electronic part transfer unit 100A. Consequently, the electronic part transfer unit 100A can be easily connected to the electronic part inspection unit 200.

(Operation of Electronic Part Inspection Apparatus 1A)

Next, an operation will be described which is conducted to inspect parts using the electronic part inspection apparatus 1A, based on the control of the control portion 190.

Fig. 16 is a timing chart, showing an operational process of the electronic part inspection apparatus 1A. Fig. 17 to Fig. 24 are top views which show the state of the electronic part inspection apparatus 1A when it operates in the operational process shown in Fig. 16.

Herein, in Fig. 16, the horizontal axis is time and the vertical axis represents an output state of a drive instruction in each of the X, Y, Z and R directions. The affixes a to d of X, Y, Z and R shown here correspond to the parts transfer mechanisms 160a to 160d, respectively. Herein, within a period of time shown in Fig. 16, absorption heads 165c, 165d do not move in the X and R directions. Thus, in Fig. 16, the description of Xc, Xd, Rc, Rd is omitted. In addition, in the following description, in order to distinguish electronic part which are held by each parts transfer mechanism 160a to 160d, the numerals of 1 to 6 are given to the reference character D.

(1) Time t0 (see Fig. 17)

At a time t0, electronic part D1, D2 are connected to the inspection sockets 152a, 152b, and are being inspected.

Herein, absorption heads 165a, 165b are pressing the electronic part D1, D2 which are connected to the inspection sockets 152a, 152b against the inspection sockets 152a, 152b, respectively. On the other hand, the absorption heads 165c, 165d are absorbing electronic part D3, D4 which are not yet inspected, and are standing by in the Y-axis minus direction (i.e., downward in Fig. 17) of the absorption heads 165a, 165b, respectively.

(2) Time t1 to t2

At a time t1, the inspection of the electronic part D1, D2 is completed.

The air pressure which is given to the inside of each absorptive nozzle 166a, 166b is switched from a positive pressure to a negative pressure. Then, the absorption heads 165a, 165b each move in the Z-axis plus direction (i.e., go upward). As a result, the electronic part D1, D2 which have been absorbed by the absorption heads 165a, 165b move apart from the inspection sockets 152a, 152b, respectively.

(3) Time t2 to t3 (see Fig. 18)

The absorption heads 165a to 165d move together in the Y-axis plus direction (i.e., upward in Fig. 18). Consequently, instead of the absorption heads 165a, 165b, the absorption heads 165c, 165d are located above the inspection sockets 152a, 152b.

(4) Time t3 to t4

At a time t3, the absorption heads 165a, 165b start to move in the X-axis minus direction (i.e., leftward in Fig. 18). Then, the absorption heads 165c, 165d move together in the Z-axis minus direction (i.e., go downward). When the absorption heads 165c, 165d reach a predetermined height position, the air pressure which is given to the tip of each absorptive nozzle 166c, 166d is switched from a negative pressure to a positive pressure. Thereby, the electronic part D3, D4 which have been absorbed by the absorption heads 165c, 165d are set to the inspection sockets 152a, 152b. Then, at a time t4, an inspection of the electronic part D3, D4 is started.

(5) Time t5 to t6 (see Fig. 19)

The absorption heads 165a, 165b move in the X-axis directions. Thereby, the absorption heads 165a, 165b and the absorption heads 165c, 165d are shifted in the X-axis directions. At this time, when the absorption head 165b passes through the absorption head 165c (i.e., when they pass each other in the X-axis directions), the absorption heads 165a, 165b move in the Y-axis minus direction (i.e., downward in Fig. 18).

In other words, when the absorption heads 165c, 165d (or the absorption heads 165a, 165b) on one side are located above the position of the inspection sockets 152a, 152b, if the absorption heads 165a, 165b (or the absorption heads 165c, 165d) on the other side are moved in the X-axis directions, then the absorption heads 165a, 165b and the absorption heads 165c, 165d interfere (or come into contact) with each other. However, as described above, the absorption heads 165a, 165b (or the absorption heads 165c, 165d) on the one side move in the X-axis directions while they retreats in the Y-axis directions. Thereby, the absorption heads 165a, 165b and the absorption heads 165c, 165d are prevented from interfering with each other. Herein, the area in which the absorption heads 165a, 165b and the absorption heads 165c, 165d interfere (or come into contact) with each other is called a head interference area (which is shown by giving reference characters Ai in Fig. 17 to Fig. 24), according to this embodiment. When the absorption heads 165a, 165b and the absorption heads 165c, 165d pass each other, as described above, the absorption heads 165a, 165b (or the absorption heads 165c, 165d) on the one side are located outside of this head interference area Ai. Thereby, the absorption heads 165a, 165b and the absorption heads 165c, 165d are prevented from interfering (or coming into contact) with each other.

(6) Time t7 to t8 (see Fig. 20)

Among the trays T for the parts that have already been inspected, the tray T1 is a tray for parts that are up to standard, and the tray T2 is a tray for parts that are up to standard. On the other hand, the electronic part D1 of the absorption head 165a are parts that are up to standard, and the electronic part D2 of the absorption head 165b are parts that are below standard. In such a case, at a time t7, the absorption heads 165a, 165b move above the trays T1, T2 for the already-inspected parts, respectively. Thereafter, the absorption heads 165a, 165b move up, and thus, the electronic part D1, D2 are stored in the trays

T1, T2 for the already-inspected parts. At this time, the absorption heads 165a, 165b move down, and thereafter, the electronic part D1, D2 are released before they move up. Thereby, the electronic part D1, D2 are stored in the trays T1, T2 for the already-inspected parts.

Herein, if both the electronic part D1, D2 of the absorption heads 165a, 165b are up to standard, the absorption head 165a (or the absorption head 165b) on one side is located above the tray T1 and is moved down. Then, the electronic part D1 is released, and thereafter, the absorption head 165a is moved up. Thereafter, the absorption head 165b (or the absorption head 165a) on the other side is located above the tray T1, and then, the electronic part D2 is released. At this time, the absorption head 165b on the other side moves in the X-axis directions, and at the same time, the absorption head 165a on the one side is allowed to retreat in the X-axis directions from above the tray T1. Thereby, the absorption heads are prevented from interfering with each other.

On the other hand, if the electronic part D1 of the absorption head 165a are parts that are below standard, and the electronic part D2 of the absorption head 165b are parts that are up to standard, then the absorption head 165a on the one side is located above the tray T2 and is moved down. Then, the electronic part D1 is released, and thereafter, the absorption head 165a is moved up. Thereafter, the absorption head 165b on the other side is located above the tray T1, and then in the same way, the electronic part D2 is released. Hence, when the absorption head 165b on the other side is set to above the tray T1, in order to prevent it from interfering with the absorption head 165a on the one side, the absorption head 165a is moved in the X-axis minus directions.

(7) Time t8 to t10

At a time t8, the absorption heads 165a, 165b start to move in the X-axis plus direction toward the tray T4 for parts which are not yet inspected. At this time, the absorption head 165b moves to a reference position in the Y-axis directions and in the R directions. Simultaneously, the Y-directions tray transfer mechanism 180 operates to move the tray T4 in the Y-axis directions. Herein, a reference position Y0 in the Y-axis directions is the middle point between the part position confirmation cameras 151a, 151b, and is shown as Y0 in Figs. 17 to 24.

(8) Time t10 to t12 (see Fig. 21)

At a time t10, the absorption head 165b on one side reaches up to above the tray T3.

Thereafter, the absorption head 165b goes down, and comes into contact with, or close to, the upper surface of an electronic part D6 which is stored in the tray T3. Then, it absorbs the electronic part D6. As a result, the electronic part D6 is taken out from the tray T3, with kept absorbed by the absorption head 165b.

From a time t10b, the absorption heads 165a, 165b move in the X-axis plus direction. Then, at a time t11, the absorption head 165a on the other side reaches up to above the tray T3. Then, between the time t11 and a time t12, in the same way as the case of the absorptive nozzle 166b on the other side, an electronic part D5 is absorbed by the absorptive nozzle 166a. At the time t12, the absorption head 165a starts to move in the X-axis plus direction toward the inspection socket 152a.

(9) Time t13 to t15 (see Fig. 22)

While moving in the X-axis directions, the absorption heads 165a, 165b move in the Y-axis plus direction. This movement in the Y-axis directions is made to prevent the absorption heads from interfering with each other within the head interference area Ai. Thus, it is made before they come into the head interference area Ai.

Thereafter, while the absorption heads 165a, 165b are moving in the X-axis directions, they pass above the part position confirmation camera 151a. Specifically, the absorption heads 165b, 165a pass, in this order, above the part position confirmation camera 151a. When they pass, an image is picked up by the part position confirmation camera 151a. Based upon the picked-up image information, the position of the electronic part D5, D6 (i.e., the position relative to the absorption heads 165a, 165b; the absorption state of the electronic part D5, D6) is recognized.

(10) Time t15 to t16

Based upon the position of the electronic part D5, D6 which have undergone the image recognition, while moving in the X-axis directions, the position of the absorption heads 165a, 165b in the Y-axis directions and in the R directions is rectified (or corrected). This helps certainly connect the electronic part D5, D6 to the inspection sockets 152a, 152b. Specifically, when the electronic part D5, D6 are stored in the tray T3, the position in which they are placed may be shifted, or such a problem may take place. This may produce an error when they are absorbed. However, the above described processing prevents such an error from being made.

(11) Time t17 to t18 (see Fig. 23)

At a time t17, the movement of the absorption heads 165a, 165b in the X-axis directions is completed. In addition, the inspection of the electronic part D3, D4 is completed.

During the period of the time t17 to a time t18, the absorption heads 165c, 165d absorb the electronic part D3, D4, and go upward.

(12) Time t18 to t19 (see Fig. 24)

The absorption heads 165a, 165b and the absorption heads 165c, 165d move all together in the Y-axis minus direction. Consequently, the absorption heads 165a, 165b are located above the inspection sockets 152a, 152b. At this time, the position of the absorption heads 165a, 165b is corrected during the time t15 to t16, and thus, the electronic part

D5, D6 are put in a suitable position (i.e., upward) so that they can be connected to the inspection sockets 152a, 152b.

(13) Time t19 to t20

The absorption heads 165a, 165b moves down, and the electronic part D5, D6 are connected to the inspection sockets 152a, 152b. Thereafter, at a time t20, an inspection of the electronic part D5, D6 starts. An operation here is basically the same as in the case during the time t3 to t4, except for the fact that the role of the absorption heads 165a, 165b is replaced by that of the absorption heads 165c, 165d.

(14) After Time t20

From this time on, the inspection of the electronic part D5, D6 continues. Then, except for the fact that the role of the absorption heads 165a, 165b is replaced by that of the absorption heads 165c, 165d, the operations which correspond to those after the time t4 are repeated and continued.

In the above described operations of the electronic part inspection apparatus 1A, the case has been described in which the inspection sockets 152 are arranged in the X-axis directions. But descriptions are omitted on how the direction in which the inspection plate 153 is attached is detected, and based on the detected attachment direction, how the position of the absorption head 165 is controlled. As a practical manner, however, the type of the inspection socket 152 and the attachment direction are detected by the inspection-position confirmation camera 154, the opening detection portion 156 or the like. Thereafter, in response to the type of the inspection socket 152 and the attachment direction which have been detected, the absorption head 165 (165a to 165d) are moved. As a result, at the times t3, t19, the absorption head 165 is located above the inspection sockets 152a, 152b.

Herein, it is enough that the type of the inspection socket 152 and the attachment direction are detected only once when the electronic part inspection apparatus 1A starts to operate.

As described hereinbefore, in the electronic part inspection apparatus 1A, the part position confirmation camera 151 is disposed in the inspection area 150. Then, the electronic part D is taken out from the tray T4 with kept absorbed by the absorption head 165. Thereafter, in this state, this electronic part D is moved to above the part position confirmation cameras 151. Then, the state in which the electronic part D is absorbed is recognized by its image. Next, based on this image recognition, a shift in the absorption is corrected. Then, the electronic part D is inserted into the inspection socket 152. Hence, until the electronic part D is inserted into the inspection socket 152 after being taken out from the tray T4, it is transferred with kept absorbed by the absorptive nozzle 166 and without being moved down at all. Therefore, while the electronic part D is recognized by its image and is precisely inserted into the inspection socket 152, the electronic part D can be swiftly transferred from the tray T4 to the inspection sockets 152a, 152b.

Particularly, the electronic part D itself which is kept absorbed by the absorptive nozzle 166 is recognized by its image, thereby making it possible to detect the absorption state precisely. Thus, the electronic part D can be inserted more precisely and more certainly into the inspection sockets 152a, 152b. Conventionally, after an electronic part which has been placed is recognized by its image, the electronic part is absorbed. In that case, if the electronic part is absorbed after the image has been recognized, a shift may be produced at that time. After that, the shift cannot be corrected, thereby preventing the electronic part from being precisely inserted into an inspection socket. However, in the electronic part inspection apparatus 1A according to this embodiment, immediately before it is inserted into the inspection sockets 152a, 152b, the electronic part D itself which is kept absorbed by the absorptive nozzle 166 is recognized by its image, so that the absorption state can be checked. Thus, there is no possibility that any absorption shift occurs later. Therefore, the electronic part D can be inserted more precisely and more certainly into the inspection sockets 152a, 152b.

Furthermore, in the electronic part inspection apparatus 1A, each tray T1 to T4 (the tray T1 for parts which are up to standard, the tray T2 for parts which are below standard, the empty tray T3, and the tray T4 for parts before they are inspected) of the tray disposition area 130, the inspection sockets 152a, 152b, and the part position confirmation camera 151a (or 151b), are arranged substantially in line. Thereby, the electronic part D which has been taken out from the tray T can be transferred almost straight in the X-axis directions. Therefore, the electronic part D can be transferred at higher speed than in any conventional such apparatus in which the electronic part D is moved over a long distance in both the X-axis directions and the Y-axis directions. Beside, the tray disposition area 130 and the like are arranged in line in the X-axis directions, thus making the layout of the tray disposition area 130 compact. Especially, the electronic part inspection apparatus 1A can be provided which has a compact configuration in the Y-axis directions.

Moreover, in the electronic part inspection apparatus 1A according to this embodiment, the two X-axis robots 120a, 120b are provided. In these X-axis robots 120a, 120b, there is provided, respectively, the pair of parts transfer mechanisms 160 (i.e., the parts transfer mechanisms 160a, 160b and the parts transfer mechanisms 160c, 160d). By the pair of parts transfer mechanisms 160, the electronic part D is transferred alternately. Therefore, the electronic part D are transferred without a break to the inspection socket

152, and thus, the electronic part D can be consecutively inspected. This allows the electronic part D to be extremely effectively inspected.

(Second Embodiment)

Fig. 25 is a top view of an electronic part inspection apparatus 1B according to a second embodiment of the present invention. The electronic part inspection apparatus 1B shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100B as described below. It is configured by combining the electronic part transfer unit 100B and the electronic part inspection unit 200.

Herein, the electronic part inspection apparatuses 1B to 10I according to the second to ninth embodiments which will be described hereinafter each have a basic configuration common to the electronic part inspection apparatus 1A according to the first embodiment. Therefore, in the following description, the portions where are common to those according to the first embodiment are given the same reference characters and numerals as much as possible. Then, their description is omitted (or simplified), and their different points are described in detail.

The electronic part transfer unit 100B according to the second embodiment is configured by: the base stand 110; the X-axis robots 120 (120a, 120b); a tray disposition area 2130 (2130a, 2130b); a stocker disposition area 2140 (2140a, 2140b); the inspection area 150; the parts transfer mechanism 160 (160a to 160d); the X-directions tray transfer mechanism 170 (170a, 170b); the Y-directions tray transfer mechanism 180 (180a to 180d); the control portion 190; and other components, and a cover is placed over it.

According to this embodiment, the base stand 110 has a substantially U-shape at its bottom part. The electronic part inspection unit 200 is inserted into a space 2111 of the base stand 110 from the Y-axis directions. According to this configuration where the bottom part of the base stand 110 is shaped like a substantially U-letter, the four corners of the base stand 110 can bear the load of such a unit. Thus, even if a mechanical force (e.g., by an earthquake) is applied, the unit could not fall down easily because of its stability.

Near the middle of the base stand 110, the inspection area 150 is located. As the tray disposition area 2130, the two tray disposition areas 2130a, 2130b are provided such that the inspection area 150 is located between them in the X-axis directions. As the stocker disposition area 2140, the two stocker disposition areas 2140a, 2140b are located so as to correspond to the tray disposition areas 2130a, 2130b, respectively.

According to this embodiment, the trays T1 to T4 are sorted and placed at each tray disposition area 2130a, 2130b. Herein, the tray T4 for parts that are not yet inspected is placed in the area different from the trays T1, T2 for parts that have already been inspected. This prevents the not-inspected electronic part D from mixing with the already -inspected electronic part D.

Herein, according to this second embodiment, as shown by a virtual line, the trays T1 to T4 can each be placed at both of the tray disposition areas 2130a, 2130b. According to this configuration, the speed of inspections can be made higher, using the four absorption heads 165 effectively. At this time, the electronic part D are transferred from the tray disposition area 2130 to the inspection area 150, and then, they are inspected, alternately between the tray disposition areas 2130a, 2130b. Thereby, the inspection area 150 is commonly used for the tray disposition areas 2130a, 2130b, and they can be effectively inspected. This sharing helps reduce production costs and an installation area for the apparatus. In this case, as the part position confirmation camera 151, two cameras are provided for each of the tray disposition area 2130a and the tray disposition area 2130b.

There is no need for the stocker 141 to have the same configuration in both of the stocker disposition areas 2140a, 2140b. For example, where the stocker 141 should be placed on a level, and which the stocker 141 should be placed, over or under the base stand 110 (i.e., in which direction the trays T should be piled), may also be varied according to the stocker disposition areas 2140a, 2140b. Herein, a configuration where the stocker 141 is placed under the base stand 110 will be described in detail according to the embodiment mentioned later.

Herein, according to this embodiment, as the X-axis robot 120, two robots are used, but only a single X-axis robot 120 may also be used (e.g., the X-axis robot 120a). In that case, in the X-axis robot 120a, two parts transfer mechanisms 160a, 160b are placed so as to be moved. According to this configuration, the two parts transfer mechanisms 160 on the X-axis robot 120a can be efficiently used, thus making inspections efficient.

In addition, in a single X-axis robot 120 (e.g., the X-axis robot 120a), the four parts transfer mechanisms 160a to 160d may also be placed. In that case, by the parts transfer mechanisms 160a, 160b, the electronic part D are transferred between the tray disposition area 2130a and the inspection area 150. Then, by the parts transfer mechanisms 160c, 160d, the electronic part D are transferred between the tray disposition area 2130b and the inspection area 150. This makes it possible to inspect the electronic part D efficiently. Herein, in this case, as the part position confirmation camera 151, it is enough that one camera is provided for each of the tray disposition area 2130a and the tray disposition area 2130b.

(Third Embodiment)

Fig. 26 is a top view of an electronic part inspection apparatus 1C according to a third embodiment of the present invention. The electronic part inspection apparatus 1C shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100C as described below. It is configured by combining the electronic part transfer unit 100C and the electronic part inspection unit 200.

In the electronic part transfer unit 100C shown in this figure, the two tray disposition areas 2130a, 2130b are provided such that the inspection area 150 is located between them in the X-axis directions. Correspondingly to these tray disposition areas 2130a, 2130b, there are provided the two stocker disposition areas 2140a, 2140b. In this respect, its configuration is common to that of the electronic part inspection apparatus 1B shown in Fig. 25. However, in the following points, it is different in configuration from the electronic part inspection apparatus 1B shown in Fig. 25.

Specifically, in the X-axis robots 120a, 120b on one side, there are placed four parts transfer mechanisms 160a, 160b and 160e, 160f. Similarly, in the In the X-axis robots 120a, 120b on the other side, there are placed four parts transfer mechanisms 160c, 160d and 160g, 160h. Among the parts transfer mechanisms 160a, 160b and 160e, 160f which are placed in the X-axis robot 120a on the one side, in the parts transfer mechanisms 160a, 160e on both outsides (i.e., on both outsides in the X-axis directions), X-directions tray transfer mechanisms 170a, 170c are disposed, respectively.

On the other hand, among the parts transfer mechanisms 160c, 160d and 160g, 160h which are placed in the X-axis robot 120b on the other side, in the parts transfer mechanisms 160c, 160g on both outsides, X-directions tray transfer mechanisms 170b, 170d are disposed, respectively. In addition, among the parts transfer mechanisms 160a, 160b and 160e, 160f which are placed in the X-axis robot 120a on the one side, in each of the parts transfer mechanisms 160b, 160f on the inside, the inspection-position confirmation camera 154 is disposed.

In each tray disposition area 2130a, 2130b, the trays T1 to T4 are disposed. In the stocker disposition areas 2140a, 2140b, the stockers 141a to 141d and stockers 141e to 141h are disposed, respectively.

In the inspection area 150, a pair of inspection plates 153a, 153b which each include the inspection sockets 152a, 152b are disposed adjacent to each other in the X-axis directions. Between the inspection plate 153a on one side and the tray disposition area 2130a on one side, the part position confirmation cameras 151a, 151b are disposed. Between the inspection plate 153b on the other side and the tray disposition area 2130b on the other side, part position confirmation cameras 151c, 151d are disposed.

In other words, in this electronic part inspection apparatus 1C, the electronic part D is inspected while the electronic part D is being transferred between the tray disposition area 2130a on the one side and the inspection socket 152 on the one side, using the parts transfer mechanisms 160a, 160b and 160c, 160d. On the other hand, apart from this, the electronic part D is inspected while the electronic part D is being transferred between the tray disposition area 2130b on the other side and the inspection socket 152 on the other side, using the parts transfer mechanisms 160e, 160f and 160g, 160h.

This electronic part inspection apparatus 1C includes double the configuration of the electronic part inspection apparatus 1A according to the first embodiment. This makes it possible to inspect the electronic part D more efficiently.

According to the configuration of this electronic part inspection apparatus 1C according to the third embodiment, the parts transfer mechanisms 160a, 160b and 160c, 160d are placed in the X-axis robot 120a on the one side, and the parts transfer mechanisms 160e, 160f and 160g, 160h are placed in the X-axis robot 120b on the other side, respectively. However, for example, as shown in Fig. 27, the parts transfer mechanisms 160a, 160b, the parts transfer mechanisms 160c, 160d, the parts transfer mechanisms 160e, 160f, and the parts transfer mechanisms 160g, 160h, may also be placed in individual X-axis robots 120a-1, 120a-2, 120b-1, 120b-2, respectively.

(Fourth Embodiment)

Fig. 28 is a top view of an electronic part inspection apparatus 1D according to a fourth embodiment of the present invention. The electronic part inspection apparatus 1D shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100D as described below. It is configured by combining the electronic part transfer unit 100D and the electronic part inspection unit 200.

The electronic part transfer unit 100D is configured by: the base stand 110; the two X-axis robots 120a, 120b; the tray disposition area 130; the stocker disposition area 140; the inspection area 150; parts transfer mechanisms 3160a, 3160b; an X-directions tray transfer mechanism 3170; the Y-directions tray transfer mechanism 180a to 180d; a control portion; and other components.

Fig. 19 and Fig. 30 are an enlarged top view and side view of the parts transfer mechanism 3160 (3160a, 3160b).

As shown in the same figure, according to this embodiment, the parts transfer mechanisms 3160a, 3160b are each include, as its base, a Y-axis robot 3162 which strides between both X-axis robots 120a, 120b. Specifically, each parts transfer mechanism 3160a, 3160b is configured by: a pair of X-directions drive portions 3161 which are placed in each X-axis robot 120a, 120b; the Y-axis robot 3162 which is supported across these X-directions drive portions 3161; a Z-directions drive portion 3163 which is moved in the Y-axis directions by this Y-axis robot 3162; an R-directions drive portion 3165 which is connected to this Z-directions drive portion 3163; an absorption head body 3166 which is connected to this R-directions drive portion 3165; an absorptive-nozzle support member 3167 which is connected to this absorption head body 3166; an absorptive nozzle 3168; and the like.

Each X-directions drive portion operates to move the Y-axis robot 3162 in the Y-axis directions. On the other hand, the Y-axis robot 3162 operates to move the Z-directions drive portion 3163 and the like in the Y-axis directions. Thereby, the absorptive nozzle 3168 is moved in the X-axis and Y-axis directions. Then, the Z-directions drive portion 3163 and the R-directions drive portion 3165 operate to move (i.e., lift) the absorptive nozzle 3168 in the Z-axis directions, and to rotate it around the R axis.

Herein, with respect to the parts transfer mechanisms 3160a, 3160b, in the parts transfer mechanism 3160a on one side, the X-directions tray transfer mechanism 3170 is provided which has the same configuration as the X-directions tray transfer mechanism 170 according to the first embodiment. In the absorption head body 3166 of the parts transfer mechanism 3160b on the other side, the inspection-position confirmation camera 154 is provided.

In the inspection area 150, the inspection plate 153 is disposed which includes the inspection sockets 152a, 152b. But between the inspection plate 153 and the tray disposition area 130, as the part position confirmation camera 151, only one camera is provided (see Fig. 13A).

As described above, the electronic part transfer unit 100D is provided with the parts transfer mechanisms 3160a, 3160b which are made up of a combination of the X-axis robots 120a, 120b, the Y-axis robot 3162 and the like. Hence, by combining such an electronic part transfer unit 100D and the electronic part inspection unit 200, an electronic part inspection apparatus 10C can be configured.

(Fifth Embodiment)

Fig. 31 is a top view of an electronic part inspection apparatus 1E according to a fifth embodiment of the present invention. The electronic part inspection apparatus 1E shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100E as described below. It is configured by combining the electronic part transfer unit 100E and the electronic part inspection unit 200.

In the electronic part transfer unit 100E shown in this figure, the two tray disposition areas 2130a, 2130b are provided such that the inspection area 150 is located between them in the X-axis directions. The stocker disposition areas 2140a, 2140b are provided so as to correspond to these tray disposition areas 2130a, 2130b.

In the same way as according to the fourth embodiment, four parts transfer mechanisms 3160a to 3160d are provided which stride between the X-axis robots 120a, 120b. Among these parts transfer mechanisms 3160a to 3160d, in each of the parts transfer mechanisms 3160a, 3160c on both outsides, the X-directions tray transfer mechanism 3170 is provided. On the other hand, in each of the parts transfer mechanisms 3160b, 3160d on the inside, the inspection-position confirmation camera 154 is provided. Herein, the basic configuration of the X-directions tray transfer mechanism 3170 is the same as that of the X-directions tray transfer mechanism 170 according to the first embodiment.

In each tray disposition area 2130a, 2130b, the trays T1 to T4 are disposed. In the stocker disposition areas 2140a, 2140b, stocker disposition areas 141a to 141d and 141e to 141h, are disposed, respectively.

In the inspection area 150, the pair of inspection plates 153a, 153b which each include the inspection sockets 152a, 152b are disposed adjacent to each other in the X-axis directions. Between each inspection plate 153a, 153b and the tray disposition areas 2130a, 2130b on their outsides (i.e., on the outsides in the Y-axis directions), the part position confirmation camera 151 is disposed, respectively.

In other words, in this electronic part inspection apparatus 1E, as described above, using the parts transfer mechanisms 3160a, 3160b which stride between the X-axis robots 120a, 120b, the electronic part D is inspected while the electronic part D is being transferred between the inspection plate 153a on the one side and the tray disposition area 2130a.

On the other hand, apart from this, using the parts transfer mechanisms 3160c, 3160d, the electronic part D is inspected while the electronic part D is being transferred between the inspection plate 153b on the other side and the tray disposition area 2130b.

This electronic part inspection apparatus 1E includes double the configuration of the electronic part inspection apparatus 1D according to the fourth embodiment. This makes it possible to inspect the electronic part D more efficiently than in the electronic part inspection apparatus 1D according to the fourth embodiment.

(Sixth Embodiment)

Fig. 32 is a perspective view of an electronic part inspection apparatus 1F according to a sixth embodiment of the present invention. The electronic part inspection apparatus 1F shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100F as described below. It is configured by combining the electronic part transfer unit 100F and the electronic part inspection unit 200.

In the electronic part inspection apparatus 1F according to the sixth embodiment, each stocker 4141 (or 4141a to 4141d) of the stocker disposition area 140 is disposed below the base stand 110. This helps lower the electronic part inspection apparatus 1F, and in this respect, it is different in configuration from the electronic part inspection apparatus

1A according to the first embodiment. This will be described in detail below. Herein, the stockers 4141a to 4141d each have the same configuration, and thus, in the following description, each stocker 4141a to 4141d is not distinguished and thus is expressed as the stocker 4141, unless they should especially be distinguished.

Fig. 33 and Fig. 34 are a side view and a front view of the electronic part inspection apparatus 1F, seen from the X and Y-axis directions in Fig. 32, respectively. Fig. 35 and Fig. 36 are a side view and a front view of the configuration of the stocker 4141, respectively.

The stocker 4141 is configured by: a lid portion 4142; four struts 4143; a bottom portion 4144; four tray separation hooks 4145; and a tray lift mechanism 4146. Inside of it, a tray-transfer-mechanism entry region 4147 is formed which the Y-directions tray transfer mechanism 180 can enter. Among these, the lid portion 4142, the upper part of the struts 4143, the tray separation hooks 4145 and the tray-transfer-mechanism entry region 4147 are disposed above (or on the upside of) the upper surface of the base stand 110. The lower part of the struts 4143, the bottom portion 4144 and the tray lift mechanism 4146 are disposed below (or on the downside of) the upper surface of the base stand 110.

The lid portion 4142 has an outside appearance of a substantially rectangular parallelepiped shape, and its lower part is opened. It has the tray-transfer-mechanism entry region 4147 inside, and in its side plane on the side of the tray disposition area 130, it has an opening which leads to the tray-transfer-mechanism entry region 4147. In addition, the two pairs of tray separation hooks 4145 are connected to it.

The strut 4143 is connected to each of the four corners of the lid portion 4142. It is a pillar which has a substantially L-shape section. It corresponds to each of the four corners of the tray T and holds the tray T in the two directions of the X axis-the Y axis.

The bottom portion 4144 is connected to the strut 4143, and is configured by a bottom plate which has a substantially rectangular shape, and four side plates. Herein, these side plates may also be excluded, and in that case, the struts 4143 are connected directly to the bottom plate which is the bottom portion 4144.

The tray separation hooks 4145 are disposed in the lid portion 4142. They are disposed on the opposite sides to each other of the tray T, so as to hold the tray T inside of the tray-transfer-mechanism entry region 4147. The tray separation hook 4145 is inserted into the concave portion of the tray T, so that the tray T can be held. To the tray separation hooks 4145, a drive mechanism (not shown) is connected, and the tray separation hooks 4145 are inserted into the concave portions on the sides of the tray T and are taken out from them. Through these insertion and taking-out, the tray T is fixed and removed.

The tray lift mechanism 4146 has a flat plate (or a tray placement plate) which the trays T that are piled is placed on, and that can be moved up and down. It is a mechanism which lifts and lowers the piled trays T inside of the stocker 4141.

The tray-transfer-mechanism entry region 4147 is a space which has a substantially rectangular parallelepiped shape that is set inside of the lid portion 4142. The Y-directions tray transfer mechanism 180 goes into it and comes out of it, from the Y-Plus direction, through the opening on the side of the lid portion 4142.

Herein, an operation for the movement of the tray T from the inside of the stocker 4141 to the tray disposition area 130 will be described using the illustrations in Fig. 37.

(1) First, the tray lift mechanism 4146 operates to lift the tray placement plate. Then, within the tray-transfer-mechanism entry region 4147, the uppermost tray T is set to a height position which corresponds to the tray separation hooks 4145 (see Fig. 37A). Herein, the Y-directions tray transfer mechanism 180 is kept outside of the tray-transfer-mechanism entry region 4147.

(2) The tray lift mechanism 4146 operates to fix the uppermost tray T within the tray-transfer-mechanism entry region 4147.

(3) The tray lift mechanism 4146 operates to move down the tray placement plate. As a result, the piled trays descend together, and only the tray T which is fixed to the tray separation hooks 4145 is held within the tray-transfer-mechanism entry region 4147 (see Fig. 37B).

(3) The Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 4147. Then, the tray separation hooks 4145 is removed, and the tray T is placed onto the Y-directions tray transfer mechanism 180 (see Fig. 37C).

In this way, the tray T which has been placed on the Y-directions tray transfer mechanism 180 is fixed to the tray placement portion 183. Then, the Y-directions tray transfer mechanism 180 retreats from the tray-transfer-mechanism entry region 4147. Thereby, the tray T is transferred from the tray-transfer-mechanism entry region 4147, and is placed in the tray disposition area 130.

On the other hand, the movement and placement of the tray T from the tray disposition area 130 to the inside of the stocker 4141 is made as described below.

(1) First, with the tray T kept placed on the Y-directions tray transfer mechanism 180, the Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 4147 from the tray disposition area 130. Thereby, the tray T is transferred to the inside of the stocker 4141 (see Fig. 37C).

(2) The state is removed in which the tray T is fixed by the tray fixing portions 184 of the Y-directions tray transfer mechanism 180. Then, the tray separation hooks 4145 operate to fix the tray T. Thereafter, the Y-directions tray transfer mechanism 180 comes out of the tray-transfer-mechanism entry region 4147 (see Fig. 37B).

(3) The tray lift mechanism 4146 operates to move up the tray placement plate. Then, when the trays T which are piled on the tray placement plate come into contact with the bottom surface of the tray T which is fixed by the tray separation hooks 4145, the tray separation hooks 4145 are removed. Thereby, all the trays T inside of the stocker 4141 are placed on the tray placement plate of the tray lift mechanism 4146 (see Fig. 37A).

(4) The tray lift mechanism 4146 operates to move down the tray placement plate. Thereby, the piled trays T move down all together inside of the stocker 4141.

In such a way as described above, the tray T on the tray disposition area 130 is placed in the uppermost part inside of the stocker 4141.

In such a way as described above, in the electronic part inspection apparatus 1F according to the sixth embodiment, the part which protrudes above the base stand 110 can be kept down. Hence, there is an advantage in that the electronic part inspection apparatus 1F can be made lower and more compact.

(Seventh Embodiment)

Fig. 38 is a perspective view of an electronic part inspection apparatus 1G according to a seventh embodiment of the present invention. The electronic part inspection apparatus 1G shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100G as described below. It is configured by combining the electronic part transfer unit 100G and the electronic part inspection unit 200.

In the electronic part inspection apparatus 1G according to the seventh embodiment, a stocker 5141 is disposed in the tray disposition area 130 of the base stand 110. In other words, the tray disposition area 130 and the stocker disposition area 140 are used in common, thereby making such an apparatus smaller. In this respect, it is different in configuration from the electronic part inspection apparatus 1A according to the first embodiment. This will be described in detail below. Herein, the stockers each have the same configuration, for example, so as to correspond to the trays T1 to T4. Thus, in the following description, they are each expressed as a stocker 5141, without distinguishing them especially.

The stocker 5141 is configured by: a lid portion 5142 (a part of which is cut off in Fig. 38); four struts 5143; a bottom portion 5144; four tray separation hooks 5145; a tray lift mechanism 5146; and the like. Inside of it, a tray-transfer-mechanism entry region 5147 is formed which the Y-directions tray transfer mechanism 180 enters. Among these, the lid portion 5142, the upper part of the struts 5143, the tray separation hooks 5145 and the tray-transfer-mechanism entry region 5147 are disposed above (or on the upside of) the upper surface of the base stand 110. The lower part of the struts 5143, the bottom portion 5144 and the tray lift mechanism 5146 are disposed below (or on the downside of) the upper surface of the base stand 110.

According to this embodiment, the lid portion 5142 is formed mainly by two side plates. Both its upper and lower parts, and both sides in the Y-axis directions, are opened. It has a tray-transfer-mechanism entry region 5147 inside. In addition, two pairs of tray separation hooks 5145 are provided.

The lid portion 5142 is opened upward so that the parts transfer mechanisms 160 can absorb and release the electronic part D from and to the tray T inside from the lid portion 5141 (i.e., within the tray-transfer-mechanism entry region 5147). The tray T is fixed by either the Y-directions tray transfer mechanisms 180 or the tray separation hooks 5145. In this state, the electronic part D are absorbed and released.

The tray T can be transferred in the X-axis directions by the X-directions tray transfer mechanism 170. This is the same as according to the first to sixth embodiments.

According to this embodiment, the absorption head 166 has access to above the uppermost tray T (because the lid portion 5142 is opened upward). Therefore, the trays T which are kept stored and piled in the stocker 5141 can be used in that state, and the electronic part D can be inspected. In this case, the electronic part D are absorbed from and

In the electronic part inspection apparatus 1G according to the seventh embodiment, as described above, the stocker disposition area 140 can be used in common with the tray disposition area 130. This presents an advantage in that the electronic part inspection apparatus 1G becomes more compact.

Herein, according to this embodiment, the stocker 5141 is disposed below the base stand 110. However, a stocker may also be disposed above the base stand 110. In that case, the lowermost tray T is moved down and placed over the tray disposition area 130.

(Eighth Embodiment)

Fig. 39 is a perspective view of an electronic part inspection apparatus 1H according to an eighth embodiment of the present invention. The electronic part inspection apparatus 1H shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100H as described below. It is configured by combining the electronic part transfer unit 100H and the electronic part inspection unit 200.

In the electronic part inspection apparatus 1H according to the eighth embodiment, a stocker 6141 stores the trays

T at each of its upper and lower parts. Thereby, the trays T can be stored efficiently. In this respect, it is different in configuration from the electronic part inspection apparatus 1A according to the first embodiment. This will be described in detail below. Herein, four stockers are disposed in the stocker disposition area 140. However, in the following description, they are each expressed as the stocker 6141, without distinguishing them especially.

The stocker 6141 is configured by: a lid portion 6142; four struts 6143; a bottom portion 6144; two pairs of tray separation hooks 6145a, 6145b; and a tray lift mechanism 6146. Inside of it, a tray-transfer-mechanism entry region 6147 is formed which the Y-directions tray transfer mechanism 180 enters. Among these, the lid portion 6142, the upper part of the struts 6143, the tray separation hooks 6145a, 6145b and the tray-transfer-mechanism entry region 6147 are disposed above (or on the upside of) the upper surface of the base stand 110. The lower part of the struts 6143, the bottom portion 6144 and the tray lift mechanism 6146 are disposed below (or on the downside of) the upper surface of the base stand 110.

The trays T are stored in the upper and lower parts of the stocker 6141. The trays T which are stored in the upper part are fixed by the tray separation hooks 6145a. The trays T which are stored in the lower part are placed on a tray placement plate of the tray lift mechanism 6146.

The lid portion 6142 has an external shape of a substantially rectangular parallelepiped, and it is opened downward. Herein, the lid portion 6142 may also be shaped like a flat plate.

The strut 6143 is connected to each of the four corners of the lid portion 6142. It is a pillar which has a substantially L-shape section. It corresponds to each of the four corners of the tray T and holds the tray T in the two directions of the X axis-the Y axis.

The bottom portion 6144 is connected to the strut 6143, and is configured by a bottom plate which has a substantially rectangular shape, and four side plates. Herein, these side plates may also be excluded, and in that case, the struts 6143 are connected directly to the bottom plate which is the bottom portion 6144.

The two pairs of tray separation hooks 6145a, 6145b are disposed up and down in the struts 6143. In each of the four struts 6143, the tray separation hooks 6145a, 6145b are disposed, and thus, the eight tray separation hooks 6145 are provided altogether in the struts 6143.

The tray separation hooks 6145a are disposed so as to fix the lowermost tray T on the upside in the stocker 6141. Besides, the tray separation hooks 6145a are disposed to fix the tray T within the tray-transfer-mechanism entry region 6147.

The tray separation hooks 6145a, 6145b are each disposed so as to correspond to the sides opposite to each other of the tray T. The tray separation hooks 6145a, 6145b are inserted into the concave portion of the tray T, so that the tray T can be prevented from falling. To the tray separation hooks 6145a, 6145b, a drive mechanism (not shown) is connected, and the tray separation hooks 6145a, 6145b are inserted into the concave portions on the sides of the tray T and are taken out from them. Through these insertion and taking-out, the tray T is fixed and removed in the Z directions.

The tray lift mechanism 6146 has a flat plate (or a tray placement plate) which the trays T that are piled is placed on, and that can be moved up and down. It is a mechanism which lifts and lowers the piled trays T inside of the stocker 6141.

The tray-transfer-mechanism entry region 6147 is a space which has a substantially rectangular parallelepiped shape that is set between the trays T on the upside and downside. The Y-directions tray transfer mechanism 180 is designed to go into it and come out of it, from the Y-Plus direction.

Herein, an operation for the movement of the tray T from the upper part of the stocker 6141 to the tray disposition area 130 will be described using the illustrations in Fig. 40.

(1) First, the tray lift mechanism 6146 operates to lift the tray placement plate. Then, the uppermost tray T which is placed over the tray placement plate comes into contact

with the bottom surface of a tray T0 (i.e., the lowermost tray T on the upside: the tray T0 to be moved) which is fixed by the tray separation hooks 6145a (see Fig. 40A).

(2) The tray separation hooks 6145a are removed, and the tray lift mechanism 6146 operates to move down the trays T by the height of one tray (i.e., move down the tray placement plate). Thereby, the tray T which is immediately above the tray T0 comes to the height position which corresponds to the tray separation hooks 6145a.

(3) The tray separation hooks 6145a operate to fix the tray T immediately above the tray T0 (i.e., the tray separation hooks 6145a are inserted into the concave portions on the sides of the tray T immediately above the tray T0) (see Fig. 40B).

(4) The tray lift mechanism 6146 operates to move down the tray T0. At this time, the tray T immediately above the tray T0 is fixed by the tray separation hooks 6145a.

Thereafter, the tray lift mechanism 6146 operates to move the tray T0 to the height position which corresponds to the tray separation hooks 6145b, or into the tray-transfer-mechanism entry region 6147.

(5) The tray separation hooks 6145b operate to fix the tray T0. Thereafter, the tray lift mechanism 6146 operates to move down the tray placement plate. As a result, only the tray T0 is fixed by the tray separation hooks 6145b, and the other trays are separated from the tray T0. In this state,

the other trays are located on both upside and downside of the stocker 6141, with both kept piled (see Fig. 40C).

(6) The Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 6147. Then, the tray separation hooks 6145b is removed. Thereby, the tray T0 is placed on the Y-directions tray transfer mechanism 180 (see Fig. 40D). Then, the Y-directions tray transfer mechanism 180 retreats from the tray-transfer-mechanism entry region 6147. Thereby, the tray T0 is carried out from the inside of the stocker 6141, and is placed in the tray disposition area 130.

On the other hand, the movement and placement of the tray T from the tray disposition area 130 to the upper part of the stocker 6141 are made as described below.

(1) First, the tray T0 to be moved is placed on the Y-directions tray transfer mechanism 180. In this state, the Y-directions tray transfer mechanism 180 goes into the tray-transfer-mechanism entry region 6147 from the tray disposition area 130. Thereby, the tray T0 is transferred into the stocker 6141 (see Fig. 40D).

(2) The fixing of the tray T0 by the Y-directions tray transfer mechanism 180 is removed. On the other hand, the tray T0 is fixed by the tray separation hooks 6145b. Thereafter, the Y-directions tray transfer mechanism 180 retreats from the tray-transfer-mechanism entry region 6147 (see Fig. 40C).

(3) The tray lift mechanism 6146 operates to lift the tray

placement plate. Then, the uppermost tray T is brought to the height position in which it comes into contact with the bottom surface of a tray T0. Thereby, all the trays T are held by the tray lift mechanism 6146. In this state, the tray separation hooks 6145b are removed (see Fig. 40B).

(4) The tray lift mechanism 6146 operates to move up the trays T by the height of one tray. Thereby, the tray T0 comes to the height position which corresponds to the tray separation hooks 6145a.

(5) The tray separation hooks 6145a operate to fix the tray T which is placed over the tray lift mechanism 6146 (see Fig. 40A). In this way, the tray T0 in the tray disposition area 130 is stored and fixed in the lowermost part on the upside of the stocker 6141.

(6) The tray lift mechanism 6146 operates to move down the tray placement plate. At this time, the tray T0 is fixed by the tray separation hooks 6145a. Thereby, it is held as it is, even though the tray placement plate descends.

In such a way as described above, the tray T in the tray disposition area 130 is stored and fixed in the lowermost part on the upside of the stocker 6141.

Herein, the tray T is stored, and taken out, in and from the lower part of the stocker 6141, in the same way as according to the sixth embodiment.

In the electronic part inspection apparatus 1H according to the eighth embodiment, the tray T can be placed, and taken out, in and from both parts above and below the tray-transfer-mechanism entry region 6147 in the stocker 6141. Hence, there is an advantage in that such a space can be used more efficiently.

(Ninth Embodiment)

Fig. 41 and Fig. 42 are schematic views of an electronic part inspection apparatus 1I according to a ninth embodiment of the present invention. Fig. 41 is a perspective view and Fig. 42 is a plan view, and each of them shows the electronic part inspection apparatus 1I.

The electronic part inspection apparatus 1I shown in this figure includes, as an electronic part transfer unit which transfers the electronic part D, such an electronic part transfer unit 100I as described below. It is configured by combining the electronic part transfer unit 100I and the electronic part inspection unit 200 (not shown). Herein, although the basic configuration according to the ninth embodiment is common to the electronic part inspection apparatus 1A according to the first embodiment, there are a large number of differences in specific configurations. Thus, the reference characters and numerals in the figures are not necessarily common to those according to the first embodiment. Some of the parts which are common to those according to the first embodiment are described again here.

As shown in these figures, there are three areas on the base stand 110 of the electronic part transfer unit 100I.

Specifically, there are: an inspection area Ta in which electronic part are inspected; a parts supply-and-discharge area Sa in which parts before they are inspected are supplied and parts after they have already been inspected (or parts which are below standard) are discharged; and a tape component area Pa (hereinafter, referred to simply as the component area Pa) in which already-inspected parts (or parts which are up to standard) are stored in a tape for a tape feeder. As shown in the same figures, these areas Ta, Sa, Pa are arranged in line in the X-axis directions (i.e., in the example shown in the figures, in the order of the areas Ta, Sa, Pa in line from the right-hand side of the apparatus). On the base stand 110, a part transferring device 1000 is further disposed which transfers parts over the areas Ta, Sa, Pa.

The part transferring device 1000 is configured by: a pair of rail members 11a, 11b which is parallel to each other and apart by a certain distance from each other in the Y-axis directions, and that extends over the areas Ta, Sa, Pa in the X-axis directions; and a pair of head units 12a, 12b (hereinafter, referred to as the first head unit 12a, the second head unit 12b) which is attached to these rail members 11a, 11b, respectively, and that can move in the Y-axis directions.

In these head units 12a, 12b, there are disposed: a pair of parts heads 13, 14 which each includes a nozzle for absorbing parts (or the absorptive nozzle 16 (see Fig. 43));

and a head 15 used for a tray which includes a nozzle for absorbing a tray (not shown), respectively. Herein, the tray head 15 is a member which corresponds to the X-directions tray transfer mechanism 170 according to the first embodiment.

The heads 13 to 15 of each head unit 12a, 12b face each other and are arranged in line in the X-axis directions inside of the rail members 11a, 11b. Each head 13 to 15 can move in the Y-axis directions, relatively to the body part of the head units 12a, 12b. Relatively to the one head 13, the other heads 14, 15 can move in the X-axis directions. According to this configuration, each head 13 to 15 can move in the X-axis and Y-axis directions, relatively in the head units 12a, 12b. Herein, the absorptive nozzle 16 can go up (i.e., move in the Z-axis directions) and rotate (i.e., turn around the Z axis) with respect to each parts head 13, 14.

In the inspection area Ta, there are disposed the inspection plate 153 which includes a pair of sockets (not shown), and the part position confirmation cameras 151a, 151b which pick up the image of a state where a part is absorbed by the absorptive nozzle 16 of each of the parts heads 13, 14.

The parts supply-and-discharge area Sa is further configured by two areas. Specifically, there are a tray area Sa1 on the side (i.e., on the right-hand side in Fig. 42) of the inspection area Ta, and a wafer area Sa2 on the side of the component area Pa.

In the tray area Sa1, there are provided: an empty-tray standby portion 31 in which the tray T (i.e., the empty tray T3) for storing parts stands by; a stocker 30 in which the empty trays T3 which are supplied to this empty-tray standby portion 31 are placed with kept piled; a part storage portion 32 in which the tray T (i.e., the tray T2) which stores, among the parts after they have, parts which are below standard, is placed; and a stocker 33 in which the trays T2 which store parts which are below standard are placed in a pile so that they can be discharged.

The empty-tray standby portion 31 and the part storage portion 32 are disposed adjacent to each other in the X-axis directions on the inside of both rail members 11a, 11b. In contrast, the stockers 30, 33 are disposed, with respect to the rail member 11b on one side (i.e., on the downside in Fig. 42), on the opposite side to the empty-tray standby portion 31 and the part storage portion 32 (i.e., on the outside of the rail member 11b), respectively. In other words, according to this embodiment, the empty-tray standby portion 31 of the tray area Sa1 corresponds to the tray disposition area 130c according to the first embodiment; the area of the part storage portion 32 corresponds to the tray disposition area 130d according to the first embodiment; the area in which the stocker 30 is disposed corresponds to the stocker disposition area 140c according to the first embodiment; and the area in which the stocker 33 is disposed corresponds to the stocker disposition area 140c according to the first embodiment.

In the tray area Sa1, there are further provided: a tray movement mechanism which moves the tray T3 which is placed in the stocker 30 to the empty-tray standby portion 31; and a tray movement mechanism which moves, to the stocker 33, the tray T2 which has stored parts (i.e., parts that are below standard) which is placed in the part storage portion 32.

These tray movement mechanisms (i.e., the container moving device according to the present invention) have a common configuration. Such a configuration will be described below, using an example of the tray movement mechanism which moves the tray T between the empty-tray standby portion 31 and the stocker 30. Herein, in the following description, the tray T2 is not distinguished from the tray T3, and thus, they are expressed as the tray T, unless they especially need to be distinguished.

As schematically shown in Fig. 43, the tray movement mechanism is configured by: a rail member 34 which is disposed below the base stand 110 and extends in the Y-axis directions; a movement member 35 which is attached to the rail member 34 so as to move; and a lift-up unit (not shown) which lifts up, from among the trays T piled on the stocker 30, the ones other than the lowermost tray T, so that the lowermost tray T can be separated from the other trays.

In the movement member 35, a hook 36 is provided which can hook the tray T from below and that can fall down. This hook 36 protrudes upward from the base stand, through an opening which is formed in the base stand 110 and is shaped like a long and narrow slit in the Y-axis directions. In this protrusion state, it can hook the tray T from below.

Specifically, as shown in the same figure, the lift-up unit operates to lift up, from among the trays T piled on the stocker 30, the ones other than the lowermost tray T. Then, the hook 36 protrudes upward from the base stand, and in this state, the movement member 35 is moved along the rail member 34. As the movement member 35 moves, the hook 36 hooks the lowermost tray T which placed in the empty-tray placement portion 30. Then, this tray T is pulled out from the empty-tray placement portion 30, and is moved to the empty-tray standby portion 31. After it has been moved, the hook 36 is switched into a falling posture (i.e., retreats downward from the base stand). In this state, the movement member 35 is reset to the empty-tray placement portion 30, and thereby, the tray T is left at the empty-tray standby portion 31.

Herein, a tray movement mechanism between the part storage portion 32 and a tray discharge portion 33 is omitted and is not shown in any figure. However, this tray movement mechanism has practically the same configuration as describe above. The tray T which lies in the part storage portion

32 is moved to the tray discharge portion 33, and then, it is inserted into the lowermost part of the trays T which have already been piled in the tray discharge portion 33.

In the wafer area Sa2, there are provided: a part standby portion 55 in which a bare chip (or a chip part) as a part stands by; a cassette setting portion 40 which sets a cassette 41 that has stored a wafer Wa; a wafer placement portion 42 which holds the wafer Wa so that it can be moved; and a bare-chip taking-out unit 50 (i.e., the chip-parts taking-out device) which takes out a bare chip to the part standby portion 55 from the wafer Wa that is placed in the wafer placement portion 42.

The part standby portion 55 is placed between the rail members 11a, 11b. The part standby portion 55 is provided with a table 55a, and a bare chip which is taken out from the wafer Wa is placed on the table 55a in a state where it can be absorbed by the head units 12a, 12b.

The cassette setting portion 40 is placed to jut out sideward (or, downward in Fig. 42) from the base stand 110. The cassette 41 which has stored the wafers WA (i.e., the wafers on which bare chips are kept diced) is designed to be set to the cassette setting portion 40 so that it can be attached and detached. In this cassette setting portion 40, a wafer inserting and taking-out mechanism is provided which inserts and takes out wafers into and from the cassette 41, though it is not shown in any figures. Using this mechanism, the wafers WA inside of the cassette 41 are taken out, and then, they are moved and placed on a stage 48 (described later) of the wafer placement portion 42.

The wafer placement portion 42 is placed between the rail member 11b on one side and the cassette setting portion 40. In this wafer placement portion 42, as shown in Fig. 44, there is provided a wafer movement unit 43.

The wafer movement unit 43 is placed below the base stand 110, and includes: a movable member 45 which can move along a pair of rail members that extends in the X-axis directions; a base member 46 which can move in the Y-axis directions with respect to this movable member 45; and a wafer placement table 48 which is held above this base member 46 by means of an up-and-down movement axis 47, so that it can be moved up and down (i.e., in the Z-axis directions). Then, the wafer Wa is supported on this table 48, and in this state, the movable member 45 moves in the X-axis directions and the base member 46 moves in the Y-axis directions. Thereby, the wafer Wa is moved on the X-Y plane (i.e., two-dimensionally).

The bare-chip taking-out unit 50 is configured by an elevated rail member 51 which extends from the wafer placement portion 42 to the part standby portion 55 in the Y-axis directions, and a movable unit 52 which can move along this rail member 51. In this movable unit 52, an up-and-down moving frame 54 is provided which can move up and down with respect to its body. An absorption head 53 which includes a nozzle for absorbing parts (or an absorptive nozzle 53a) is disposed in this up-and-down moving frame 54, and is held so that it can rotate around the horizontal axis with respect to this up-and-down moving frame 54.

In brief, in this wafer area Sa2, the wafer Wa is taken out from the cassette 41 which is set at the cassette setting portion 40. Then, it is moved and placed onto the wafer placement table 48 of the wafer placement portion 42. Next, using the bare-chip taking-out unit 50, bare chips are taken out one by one to the part standby portion 55 from the wafer Wa on this wafer placement table 48.

Using the bare-chip taking-out unit 50, bare chips are taken out as described below. Specifically, as shown on the left side in Fig. 45, the absorptive nozzle 53a is directed downward. In this state, the movable unit 52 is put in a predetermined chip-absorption position above the wafer placement portion 42. Thereafter, the up-and-down moving frame 54 moves up and down with respect to the movable unit 52. As it moves up and down, through an opening portion 49 of the base stand 110, a bare chip is picked up from the wafer Wa, with kept absorbed by the absorptive nozzle 53a. At this time, the above described wafer movement unit 43 operates to move the wafer Wa. Thereby, the bare chip to be taken out is put in the position opposite to the absorptive nozzle 53a, and in the height position where it is taken out. Then, the bare chip is picked up, and thereafter, the movable unit 52 is located at the part standby portion 55. As shown on the left side (or by the broken line) in the same figure, the bare chip is placed on the table 55a, face up, in other words, in the posture where the bare chip is absorbed by the absorptive nozzle 16 and is kept picked up from the wafer Wa. Or, as shown by the solid line, it is held above the table 55a, face down, in other words, in the posture where the bare chip is kept absorbed, and the bare chip is turned over up and down by the rotation of the absorption head 53.

Herein, in Fig. 41 and Fig. 42, reference numeral 56 denotes a chip recognition camera which is placed above the wafer placement portion 42. It is fixed to the base stand 110 by a support arm 57. This chip recognition camera 56 includes an image pick-up device such as a CCD area sensor. In order to recognize whether or not there is a mark (or a bad mark which is described later) which is written on the bare chip, it picks up the image of each bare chip of the wafer Wa through the opening portion 49 of the base stand 110.

The component area Pa is an area where a tape for a tape feeder used in an apparatus which mounts electronic part is produced. Specifically, it is an area where an operation is performed for storing already-inspected bare chips (i.e., up-to-standard parts) in a special-purpose tape. It is configured as described below.

In the component area Pa, on one side (i.e., on the upside in Fig. 42) with respect to the rail members 11a, 11b, there is supported a reel 62 around which a base tape 63 is rolled. Herein, the base tape 63 is provided with a large number of concave portions in line which are used to store parts. On the other side opposite to the reel 62 with respect to the rail members 11a, 11b, there is supported a reel 61 around which a reel 60 and a product tape 61 are rolled. Herein, a cover tape is wound around the reel 60. Between both rail members 11a, 11b, there is provided a part storage portion 64. The base tape 63 which is introduced from the reel 62 passes through this part storage portion 64. Then, it is led to the reel 61 and is wound up around the reel 61. Immediately before that, the cover tape is stuck on the base tape 63, so that the openings of the concave portions are covered. In other words, in the concave portions of the base tape 63 which passes through this part storage portion 64, the already-inspected bare chips (i.e., the up-to-standard parts) are stored one after another. Then, the cover tape is attached, so that the concave portions are closed.

Though it is not shown in any figure, this electronic part inspection apparatus 10I also includes the control portion 190, in the same way as in the electronic part inspection apparatus 1A according to the first embodiment and the like.

All the operations of the above described head units 12a, 12b and the like are systematically controlled by this control portion. Hereinafter, an example of the operation of the electronic part inspection apparatus 10I by this control portion will be described, using the flow chart in Fig. 46.

If an operation starts for an inspection, first, a decision is made whether or not the wafer Wa has been taken out from the wafer placement portion 42 (in a step S1). If the decision is made that the wafer Wa has not been taken out, the wafer Wa is taken out from the cassette 41 which is set at the cassette setting portion 40. Then, it is moved and placed onto the table 48 of the wafer movement unit 43 (in a step S2).

Next, an image of the wafer Wa which has been placed onto the table 48 is recognized (in a step S3). Specifically, among the bare chips which have been diced, the ones which are already defective in shape in their manufacturing process are each given a bad mark in the pre-process. In a step S4, the wafer movement unit 43 operates to move the wafer Wa relatively to the chip recognition camera 56, and an image of each bare chip is picked up. Thereby, among the bare chips in the wafer Wa, the position (or coordinates) of a bare chip with a bad mark is recognized using its image.

When the image recognition of such a bare chip is completed, the movable unit 52 is put in a predetermined parts taking-out position. The wafer movement unit 43 operates to move the wafer Wa relatively to the movable unit 52, so that a bare chip to be taken out faces the absorption head 53. Then, the bare chip is taken out (in the step S4).

After the bare chip has been taken out by the absorption head 53, a decision is made whether or not it should be turned over (in a step S5). If the decision is made that it should not be turned over (i.e., there is no turn-over), the movable unit 52 moves to the part standby portion 55. Then, the bare chip is placed face up onto the table 55a (in a step S6). On the other hand, If the decision is made that it should be turned over (i.e., there is a turn-over), after the movable unit 52 moves to the part standby portion 55, the absorption head 53 rotates to place the bare chip face down above the table 55a (in a step S12).

Next, the first head unit 12a (or the second head unit 12b) is moved above the part standby portion 55. Thereafter, the parts heads 13, 14 operate to allow the first head unit 12a (or the second head unit 12b) to absorb the bare chip on the table 55a, or the bare chip which is absorbed and held by the absorption head 53 (in a step S7).

When a part (i.e., the bare chip) is absorbed by the first head unit 12a (or the second head unit 12b), the first head unit 12a (or the second head unit 12b) is moved, and thereby, the bare chip is located above the part position confirmation camera 151a (or 151b). Then, the state in which the bare chip is absorbed is recognized (in a step S8).

Thereafter, the first head unit 12a (or the second head unit 12b) is placed above the inspection plate 153. Then, the parts heads 13, 14 descend, and thus, the bare chip is inserted into the socket of the inspection plate 153. Then, the bare chip is inspected (in a step S9). At this time, in response to the recognition result in the step S8, the operation of the first head unit 12a (or the second head unit 12b) is controlled. Thereby, the bare chip is properly inserted into the socket. During the inspection, the bare chip is kept absorbed by the parts head 13 or the like. Thus, the inspection is conducted with the bare chip pressed downward by the parts head 13 or the like.

In this way, the inspection is completed, and then, a decision is made whether or not the inspection result is a pass (in a step S10). In response to the result, sorting is conducted. Specifically, if the inspection result is not a pass, the first head unit 12a (or the second head unit 12b) operates to store the bare chip as it is in the tray T of the part storage portion 32 (in a step S13). On the other hand, if the inspection result is a pass, the first head unit 12a (or the second head unit 12b) operates to carry the bare chip as it is to the component area Pa and to store it in the tape (i.e., the base tape 63). In this way, a series of operations for inspecting the bare chip is completed.

Herein, during the above described inspection operations, the tray T2 for below-standard parts which has been placed in the part storage portion 32 is fully loaded. At that time, the tray T2 is sent out to the stocker 33. Then, the new empty tray T3 is carried in, and thus, the tray T is replaced, as described below. First, the tray movement mechanism operates to send out the tray T2 which is now used in the part storage portion 32 from the part storage portion 32 to the stocker 33. Next, the first head unit 12a (or the second head unit 12b) moves to above the empty-tray standby portion 31. After the tray absorption head 15 has absorbed the empty tray T3, the head unit 12a moves to the part storage portion 32. Thereby, the empty tray T3 is moved and replaced in the part storage portion 32. Thereby, the empty tray T3 is used as the tray T for storing parts which are below standard. After this replacement has been completed, the tray movement mechanism operates to pull out the next empty tray T3 which is placed in the stocker 30 to the empty-tray standby portion 31.

Herein, in the above described electronic part inspection apparatus 10I according to the ninth embodiment, in the case where a bare chip which has been taken out from the wafer Wa is inspected face up, the bare-chip taking-out unit 50 may also be omitted. In this case, for example, as shown in Fig. 47, instead of the above described table 55a, the configuration of the wafer placement portion 42 is provided in the part standby portion 55. Specifically, the opening portion 49 through which a bare chip is taken out is formed in the base stand 110, and below it, the wafer movement unit 43 is provided. Using the head units 12a, 12b (or the parts heads 13, 14), a bare chip is absorbed directly from the wafer Wa which is held on the table 48, and then, it is taken out.

According to this configuration, after a bare chip has once been absorbed by the head units 12a, 12b, the bare chip is not received and carried out at all, before an inspection is completed and the bare chip is stored in the tape (i.e., the base tape 63) or the like. Hence, there is an advantage in that a bare chip can be inspected more securely.

Herein, in this case, in Fig. 45, the cassette setting portion 40 may also be provided in the part where the wafer movement unit 43 is disposed. According to such a configuration, the cassette setting portion 40 is prevented from jutting out sideward from the base stand 110. Hence, there is an advantage in that the space which is occupied by the apparatus becomes smaller.

In such an electronic part inspection apparatus 10I according to the ninth embodiment, the inspection plate 153, the part standby portion 55 and the part storage portions 32, 64 are arranged in line, and thus, as the part transferring device 1000, it is enough that the head units 12a, 12b are simply configured to move straight. Hence, there is an advantage in that the configuration of the apparatus can be simplified. Besides, in this apparatus, as described above, the head

15 for a tray is placed in the head units 12a, 12b. As a means for moving and replacing (or transferring) the empty tray T3 from the empty-tray standby portion 31 to the part storage portion 32, the head units 12a, 12b for transferring parts are also used. In other words, an economical and efficient configuration is realized. Therefore, the configuration of the apparatus become simpler than in the case where a means for transferring only a tray is provided. In addition, this simpler configuration helps provide the apparatus at a lower price.

Furthermore, according to this configuration, the electronic part inspection apparatus 1I includes the function (i.e., the component area Pa) of producing a tape for a tape feeder which is used in the apparatus that is practically installed. Hence, there is an advantage in that the performance of a bare chip which is stored in the tape becomes more reliable. In other words, in the electronic part inspection apparatus 1I, after being inspected, a bare chip which is held by the head units 12a, 12b is stored as it is in the base tape 63, and it becomes a product. Therefore, in a process where it becomes a tape product, there is no need to transfer a bare chip between transfer mechanisms. This prevents it from receiving an adverse effect, such as an impact or static electricity. Thus, the bare chip which is stored in the tape can be properly protected from physical destruction or the like, and the performance of a bare chip which is stored in the tape becomes more reliable.

Herein, in the electronic part inspection apparatus 1I according to the ninth embodiment, such a configuration as described below can be used.

For example, in the case where a bare chip which is taken out from the wafer Wa is constantly inspected face up, the bare-chip taking-out unit 50 may also be omitted. In that case, for example, as shown in Fig. 47, instead of the table 55a, the configuration of the wafer placement portion 42 is provided in the part standby portion 55. Specifically, the opening portion 49 through which a bare chip is taken out is formed in the base stand 110, and below it, the wafer movement unit 43 is provided. Using the head units 12a, 12b (or the parts heads 13, 14), a bare chip is absorbed directly from the wafer Wa which is held on the table 48, and then, it is taken out.

According to this configuration, after a bare chip has once been absorbed by the head units 12a, 12b, the bare chip is not received and carried out at all, before an inspection is completed and the bare chip is stored in the tape (i.e., the base tape 63) or the like. Hence, there is an advantage in that a bare chip can be inspected more securely.

Herein, in this case, in Fig. 45, the cassette setting portion 40 may also be provided in the part where the wafer movement unit 43 is disposed. According to such a configuration, the cassette setting portion 40 is prevented from jutting out sideward from the base stand 110. Hence, there is an advantage in that the space which is occupied by the apparatus becomes smaller.

(Other Embodiments)

The present invention is not limited to the above described embodiments, and thus, it can be expanded and varied. Any expanded and varied embodiments are also within the scope in the art of the present invention.

(1) According to the first embodiment, in order to connect the electronic part D to the inspection socket 152 more certainly, based on the recognition of its image, a shift in the absorption of the electronic part D is corrected using software. However, for example, a part position adjustment mechanism may also be provided which mechanically adjusts the position of the electronic part D.

Figs. 48A,B are enlarged top view and sectional view of an example of a part position adjustment mechanism 400. Herein, the part position adjustment mechanism 400 can be placed in any position on a base stand of an electronic part transfer unit.

Using the part position adjustment mechanism 400, the position of the electronic part D can be adjusted. This makes it possible to omit a part position confirming means such as a part position confirmation camera.

The part position adjustment mechanism 400 shown in Fig. 48 is configured by a positional-reference portion 401, and a guide portion 402.

The positional-reference portion 401 is positioned to predetermined coordinates (X, Y, R) in the electronic part inspection apparatus 1A. In addition, it is a concave portion which is formed so as to correspond to the external shape of the electronic part D. In this example, the external shape of the electronic part D is regarded as a rectangular flat plate, and thus, the positional-reference portion 401 is configured by a concave portion which is shaped like a substantially rectangular parallelepiped and whose bottom has a rectangular shape.

The guide portion 402 has the function of a guide which leads the electronic part D to the positional-reference portion 401. It is formed by a concave portion which is slightly larger than the external shape of the electronic part D. In this example, it is formed by the concave portion which is shaped like a substantially trapezoidal regular-pyramid that has sides which extend to the four apexes of the bottom surface of the positional-reference portion 401.

Fig. 49 shows the mechanism of a positional adjustment by the part position adjustment mechanism 400. As shown in this figure, in the case where a positional adjustment is made by the part position adjustment mechanism 400, for example, the electronic part D is absorbed by the absorptive nozzle 166 (or the absorptive nozzle 16 of the head units 12a, 12b according to the ninth embodiment) of the parts transfer mechanism 160. Then, it is transferred up to above the part position adjustment mechanism 400 (see Fig. 49A). Then, the absorptive nozzle 166 is moved down and releases the electronic part D, so that it is placed (or falls) into the guide portion 402 of the part position adjustment mechanism 400. Thus, the electronic part D which has been placed on the part position adjustment mechanism 400 is led, by its own weight (i.e., gravitation), along the guide portion 402 to the positional-reference portion 401. Then, it reaches a reference position, and its position is adjusted (see Fig. 49B).

Thereafter, the electronic part D is absorbed by the parts transfer mechanism 160, so that the position of the electronic part D is corrected with respect to the parts transfer mechanism 160 (see Fig. 49C). Thereby, the electronic part D is precisely attached to a socket for an inspection, or such an operation is accurately conducted.

Fig. 50 is a top view of another example of the part position adjustment mechanism (i.e., a part position adjustment mechanism 410). This part position adjustment mechanism 410 is configured by two positional-reference walls 411, 412.

Each positional-reference wall 411, 412 is positioned to predetermined coordinates (X, Y, R) in an electronic part inspection apparatus. In addition, they are each a wall (a concave portion) which is formed so as to correspond to the external shape of the electronic part D. In this example, the external shape of the electronic part D is regarded as a rectangular flat plate, and thus, the positional-reference walls 411, 412 have reference surfaces which correspond to the two sides.

Fig. 51 shows the mechanism of a positional adjustment by this part position adjustment mechanism shown 410. As shown in this figure, in the case where a positional adjustment is made by the part position adjustment mechanism 410, for example, the electronic part D is absorbed and moved by the absorptive nozzle 166 (or the absorptive nozzle 16 of the head units 12a, 12b according to the ninth embodiment) of the parts transfer mechanism 160. Then, it is transferred up to above the part position adjustment mechanism 410. Thereafter, the electronic part D is placed near the corner of the positional-reference walls 411, 412 of the part position adjustment mechanism 410 (see Fig. 51A).

Then, the position of the electronic part D is adjusted so that one side of the electronic part D is pressed against the reference surface of the positional-reference wall 411 (see Fig. 51B). Next, the one side of the electronic part D is kept pressed on the reference surface of the positional-reference wall 411. In this state, the electronic part D is moved to the position in which another side of the electronic part D is pressed against the reference surface of the positional-reference wall 412. In this way, the electronic part D is pressed on both reference surfaces of the positional-reference walls 411, 412. Thereby, the position of the electronic part D is adjusted.

Thereafter, the electronic part D is absorbed by the parts transfer mechanism 160, so that the position of the electronic part D is corrected with respect to the parts transfer mechanism 160 (see Fig. 51C). Thereby, the electronic part D is precisely attached to a socket for an inspection, or such an operation is accurately conducted.

(2) According to the first embodiment, even in any of the apparatuses, the pair of X-axis robots 120 (or the rail members 11a, 11b according to the ninth embodiment) are provided on both sides (i.e., both sides in the Y-axis directions) with respect to the tray disposition area 130, and the absorptive nozzle 166 or the like moves on both sides of the tray disposition area 130. However, of course, a single X-axis robot 120 or the like may also be provided. In that case, the absorptive nozzle 166 or the like is moved on only one side of the tray disposition area 130. According to such a configuration, the area in which the apparatus is installed in the Y-axis directions becomes smaller.

(3) According to the first embodiment, the two parts transfer mechanisms 160 are provided on the track of one X-axis robot 120. However, one parts transfer mechanism, or three or more, may also be provided on the track of one X-axis robot 120.

Furthermore, what kinds of means should form the configuration on the X-axis rail which is the track of the

X-axis robot 120 can be suitably designed. For example, Fig. 52 is a representation, showing an example of the relation between an X-axis rail and a parts transfer mechanism.

In Fig. 52A, an X-axis robot is configured by providing two parts transfer mechanisms 512a, 512b on an X-axis rail 511. This is a configuration which corresponds to that according to the first embodiment. For example, it can be realized using a linear motor.

In Fig. 52B, an X-axis robot is configured by providing parts transfer mechanisms 522a, 522b on X-axis rails 521a, 521b, respectively. For example, it can be realized using a linear motor.

In Fig. 52C, parts transfer mechanisms 532a, 532b are provided on X-axis rails 531a, 531b, respectively. Herein, the X-axis robot 531a, 531b are each configured, using a ball screw. These ball screws are rotated, and thereby, the parts transfer mechanisms 532a, 532b are moved on the X-axis rails 531a, 531b as the ball screws, respectively.

In Fig. 52D, a base body 542 is provided on an X-axis rail 541. On this base body 542, there are provided parts transfer mechanisms 543a, 543b. Using a relatively-moving device 544, the relative position between the parts transfer mechanisms 543a, 543b in the X-axis directions can be changed on the base body 542. This is a configuration similar to that according to the ninth embodiment.

Herein, the X-axis rail 541 and the relatively-moving device 544 can each be configured, for example, by a ball screw. These ball screws are rotated, and thereby, the base body 542 is moved on the X-axis rail 541, and the relative position between the parts transfer mechanisms 543a, 543b is changed. These movements can be made independently. Herein, the X-axis rail 541 and the relatively-moving device 544 may each also be configured by a linear motor.

(4) For example, according to the first embodiment, Y-directions drive portion 162 is provided in the parts transfer mechanism 160. Thereby, the absorptive nozzle 166 can be moved in the Y-axis directions. However, for example, a Y-axis robot may also be provided on the base stand 110, so that this Y-axis robot can move the X-axis robot 120 in the Y-axis directions. Thereby, the absorptive nozzle 166 is moved in the Y-axis directions. In this case, as the X-axis robot 120, one or two robot can be used.

(5) According to the first embodiment, the empty tray T3 is provided in the tray disposition area 130 which is provided on the base stand 110 and between both X-axis robots 120a, 120b. However, the empty tray T3 may also be provided out of this area.

In this case, a stocker which stores the empty tray T3 can be separately provided. Hence, using a tray transfer mechanism which is exclusively used, the empty tray T3 is transferred between the tray disposition areas 130a, 130b, 130c.

(6) According to the first embodiment, the single absorptive nozzle 166 is provided in the absorption head 165. However, two or more absorptive nozzles 166 may also be provided. In addition, the number of sockets for an inspection of the inspection plate 153 may also be one, or more than two. This is the same as according to the other embodiments.

(7) The area on the tray T may also be divided in two in the Y-axis directions, so that they correspond to the parts transfer mechanisms 160 which are provided in the X-axis robots 120 according to the first embodiment, respectively. In these division areas, electronic part are transferred separately by each of the parts transfer mechanisms 160 which are provided in the X-axis robots 120. This helps shorten the distance by which the parts transfer mechanism 160 moves in the Y-axis directions. Besides, it also helps shorten the distance by which the tray T moves in the Y-axis directions by the Y-directions tray transfer mechanism 180. Therefore, the size of the apparatus in the Y-axis directions can be made smaller.

(8) According to the first embodiment, communications are exchanged between the electronic part transfer unit 100A and the electronic part inspection unit 200. However, these communications are not necessarily needed. For example, the inspection socket 152 is monitored, using the inspection-position confirmation camera 154. When it is confirmed as a trigger that the electronic part D has been

attached to the inspection socket 152, the electronic part D starts to be transferred and inspected. Or, on the inspection socket 152, a mark is formed which shows the type of such a socket and the contents of an inspection. Using the inspection-position confirmation camera 154, this is read so that the contents of an inspection or the like can be selected. As a result, there will be no need for the above described communications. Herein, as the inspection contents, there are the type of the electronic part D to be inspected, the process of an inspection, and the like. In this case, if a table is prepared which shows the relation between this mark and the inspection contents, proper inspection contents can be selected by referring to this table.

(9) According to the first embodiment, in the inspection area 150, in order to prevent the parts transfer mechanisms 160 (or the absorption heads 165) which are provided in the different X-axis robots 120 from interfering with each other, one of the absorption heads 165 which may interfere with each other retreats in the Y-axis directions. However, the operation for preventing such interference may also be conducted, of course, out of the inspection area 150.

Furthermore, if the plurality of parts transfer mechanisms 160 which are provided in the common X-axis robots 120 are moving in the directions where they come close to each other, then the parts transfer mechanism 160 on one side, or the parts transfer mechanisms 160 on both sides,

are moved in the directions opposite to the directions where they are going. Thereby, the parts transfer mechanisms 160 can be prevented from colliding with each other. In this case, for example, a detecting device can be provided which detects, according to the output of the above described encoder, the fact that both parts transfer mechanisms 160 have come close within a certain distance between them. Based upon the detection by the detecting device, the above described operation for preventing such a collision can be conducted.
(10) According to the first embodiment, the direction in which the inspection plate 153 (or the inspection sockets 152a, 152b) is attached is detected, by detecting the opening portion 155 which is formed in the inspection plate 153 using the opening detection portion 156 (e.g., an optical sensor, a limit switch or the like) on the side of the base stand 110. Instead of this, another means can also be used for detecting the direction in which the inspection plate 153 is attached.

① For example, in the apparatus according to the first embodiment, a mark (e.g., a dotted or crossed mark) is formed on the inspection plate 153. The mark on the inspection plate 153 is confirmed using the inspection-position confirmation camera 154. Thereby, the direction in which the inspection plate 153 or the inspection sockets 152a, 152b are attached, and in addition, if necessary, their position (i.e., their coordinates in the X and Y-axis directions), can be detected.

In this way, if the position of the inspection plate 153 is detected in advance, the electronic part D can be connected more precisely and certainly to the inspection sockets 152a, 152b.

② A mark (e.g., a dotted or crossed mark) is formed on each inspection socket 152a, 152b. The mark on each inspection socket 152a, 152b is confirmed using the inspection-position confirmation camera 154. Thereby, the direction in which each inspection socket 152a, 152b is attached can also be detected. In this case, the direction and position (i.e., their coordinates in the X and Y-axis directions) of the inspection sockets 152a, 152b themselves can be directly detected. The electronic part D can be certainly connected to the inspection sockets 152a, 152b.

③ The number of such marks which are formed on each of the inspection plate 153 and the inspection sockets 152a, 152b may be one, or two or more. For example, two marks are formed on any of the inspection plate 153 and the inspection sockets 152a, 152b, and an image of these marks is picked up by the inspection-position confirmation camera 154. Based on the coordinates of the two marks, the position and direction of the inspection sockets 152a, 152b can be detected. In this case, the marks which are put in different positions are used, and thereby, the position and direction of the inspection sockets 152a, 152b can be more precisely detected.

④ Even without such a detecting device as described above for detecting the direction of an attachment, the position and direction of the inspection sockets 152a, 152b may also be detected. For example, an operator can conduct an input operation, using an input means (such as an input switch, a mouse and a keyboard).

Herein, the above described (Other Embodiments) have been described, mainly by targeting the electronic part inspection apparatus 1A according to the first embodiment. However, of course, they can be provided even according to the first to ninth embodiments.

Industrial Applicability

As described hereinbefore, in the electronic part inspection apparatus according to the present invention, electronic part which are placed in the part standby portion are transferred to the inspection portion by the part transferring device. Then, after a predetermined inspection is conducted here, using the part transferring device, the electronic part after they have been inspected are transferred to the part storage portion which corresponds to the inspection result, and they are stored in it. This electronic part inspection apparatus is especially useful in inspecting electronic part efficiently and precisely.